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# Economy is the Antithesis of Extravagance

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# EDITORIAL

RECENT events in Europe would indicate that General Sherman's definition of war is an unjust reflection upon the summer residence of His Satanic Majesty.

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GASOLINE at 10½ cents per gallon may please the motorist, but how about the producer and refiner? A cut to 37½ cents per barrel for heavy crude at the well is a warning that overproduction must cease.

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HANS PEDERSON of Seattle, appearing as the only bidder for the construction of the Twin Peaks tunnel, will receive the contract. His estimate was $3,475,300; the time required to complete work being 1000 days. The estimate of the city engineer was $3,347,823.23. Mr. Pederson has undertaken a big job, one from which many of the greatest contracting organizations shied. All the more credit to him for his nerve and determination, and we wish him good luck and a substantial profit.

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AN ingenious innovation along the lines of serving the public is the human 'lost and found' department which is to be inaugurated at the Panama-Pacific Exposition. It will consist of a central registration bureau in connection with some thirty telephone stations about the Exposition grounds and with all outside stations on the Pacific coast. If Mr. Visitor from the wilds of New Jersey, for instance, should become separated from his family, he may telephone or call upon the 'lost and found' department, and it is to be expected that those from whom he has become separated will do likewise. Thus they may become united once more and be spared the annoyance of calling upon the police for assistance.

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GOOD roads, especially in the rural districts, are an investment, not an expense. This is shown in a striking manner by the report of Mr. U. S. Collins, superintendent of schools at Medford, Oregon. All records for registration of new pupils have been broken this fall, the new hard surface roads recently constructed having made it just as easy for students to attend school in winter as in summer. The completion of the Pacific highway between Medford and Central Point on the north and Ashland on the south has accounted for a registration of 1273 at the Medford school for the winter term.

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AN interesting example of the durability of pipe made from California redwood has been shown at Santa Cruz, California. The city water department on the occasion of some excavations on Mission at Vine streets unearthed a section of the original water pipe of Santa Cruz, installed in the early days. The pipe was made of hewn timbers, through the centre of which a 4-inch hole had been bored. The redwood is in an almost perfect state of preservation, indicating the remarkable properties of the wood in resisting decomposition when underground. The old section of pipe has been placed on exhibition at the Chamber of Commerce and is the centre of an interested group of spectators.

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EVERY now and then accounts will be found in the daily press about the failure of some kind of concrete construction. These accounts are generally non-technical and superficial, and having served their purpose as a story of the moment, are discarded and forgotten without heed to the damage they may do through the medium of the press clipping bureaus and rival commercial interests. In Los Angeles, a few days ago, the Board of Public Works found on inspection that from 150 to 200 feet of the concrete work in the Third Street tunnel would have to be torn out by reason of defects in construction. It was stated that the concrete base had been badly crushed by the 15-ton roller used in compacting the asphaltic surface. Here in California somewhat similar occurrences took place in the case of the section of the new state highway between Santa Rosa and Healdsburg. Opponents of the type of paving adopted were quick to ascribe the defects in this road to the material used rather than to the way it was used, and for a while doubt was instilled in the minds of many people as to the good judgment of the California Highway Commission. Ultimately the truth came out, and criticism was stilled. Specifications for concrete road work are now drawn up which, with the aid of rigid inspection, will do much to minimize such occurrences, nevertheless, the human element will always be a factor in concrete work as well as in other walks of life.

The chief cause of failure in laying concrete base for roads is the desire of the contractor to rush the mixer beyond its ability to turn out a correct mix. Manufacturers' ratings are often ignored, and the contractor increases the rated number of turns of the mixer barrel to the detriment of the mix. It has been found that the contractor who can average 12,000 square feet of 4-inch base on state highway work for an eight-hour day can make a good profit and turn out good work, if his crew is properly organized. Large daily runs, accomplished periodically, are generally made at a sacrifice of efficiency for the days following. The city of Los Angeles has adopted a rule limiting the daily output of a single mixer to 16,000 where a 5-inch base is being laid,

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and other authorities have adopted rules prescribing the number of turns to be given the mixer barrel for each batch. Both of these are steps in the right direction and will do much to insure good work. Manufacturers of mixers are taking up the question in order that no injustice may be done to their apparatus by slipshod construction methods, and it seems that the criticism directed by some contractors toward the Highway Commission may be turned with profit in their own direction. There is room for improvement on both sides.

## The Extravagance of Economy

Retrenchment is a word that is on everyone's lips. All hands, from the highest government officials down, are carrying this message to the people. Even in the halls of Congress, where the greatest organization of spenders in the world holds forth, the appropriation for the improvement of rivers and harbors, commonly known as the 'pork barrel,' has been sliced in a manner most unprecedented. Bankers, notoriously timid as a class, are building trenches and fortifying their positions in order to be prepared for whatever emergency that may arise.

Nevertheless, in a commercial sense, how many of us really know what retrenchment really means? The feeling that we must all economize is so general that a business depression has come into existence created largely by ourselves. The effect of the war in Europe upon various American industries is in many cases definitely fixed for the time being. Exports of certain commodities to Europe have ceased, and the machinery of commerce, especially the transportation part of it, is not yet in such working order that we may take advantage of the new markets that by reason of this same European war are now available.

When, for any reason, a business house becomes infected with the economy germ, the first appropriation to be cut is that for sales promotion. Why? It is doubtful if a logical answer could be given. If one cares to listen, reasons may be heard such as "Business is so slack that we don't need so many or such high-priced salesmen," "There is no use in our going to the expense of figuring on this work, competition is so keen that somebody will take it below cost anyway," "There is no use in advertising now, no one is buying anything." And so it goes.

Again, why is it that when business is plentiful, appropriations for sales promotion may be coaxed from boards of directors almost without effort, and when times are dull and most extraordinary efforts must be made to keep up factory output, the almost universal policy of business managements is to curtail the means for getting business? True, it costs more to get business when the demand is slight than when it is great, but is there anything more expensive than no business at all? Inertia is just as much a property of buying and selling as of matter. If a business concern should, without warning, discharge its entire sales force, orders would continue to come in by mail, for a while. If a great advertiser should suddenly cease all advertising, his sales organization would continue to do business, and depending upon the importance and standing of the advertiser in question, it might be some time before the change of policy would make itself manifest, not only in the diminution of his own sales, but in the increase of those of his competitors.

The change, however, would come. It is inevitable. And when the clouds of business depression roll away, the business man who has by his policy of 'retrenchment' proclaimed to the world that he has been hibernating during the hard winter, will find that extraordinary efforts on his part will have to be made to regain the place in the race from which he has stepped aside. Electric power men shun a load composed of a series of alternating peaks and valleys, for the reason that it brings about a succession of severe strains upon the generating apparatus and makes regulation almost impossible. Directors of business enterprises will do well to take to heart the analogy of this instance to their own affairs.

There is another phase of the question that is more psychological than economic. We have during the past two months visited the offices of many of the leading business concerns on the Pacific coast. In the offices of some the air of gloom starts with the manager and is reflected in all its depressing intensity upon every employee down to the office boy. On entering the offices of such a concern, it is almost instinctive to walk on tip-toe for fear of disturbing the slumbers of the late lamented. A buyer, and there are still a few, would be repelled by the forbidding atmosphere alone.

Other offices, however, shine in pleasing contrast. The manager is cheerful and determined, and his subordinates likewise. While there is no 'boost' talk, the spirit of 'get there somehow, but get there we will' is pleasant after the funereal aspect encountered elsewhere.

The duties and responsibilities of the manager of a business are many, and perhaps the most important of them all is to inspire his subordinates, by force of example, to new and increased efforts. As is to be expected, concerns of the latter type are increasing rather than diminishing their sales promotion work, and their expenditures for this purpose, while not larger than usual, are being directed with a keener eye toward permanent results than ever before.

Concerns of the former type, however, will probably continue to indulge in the extravagance of economy. They will spend of their priceless time, which once gone can never come back. Their house will remain in disorder, their machinery of trade rust from disuse; they will hoard such funds as they have, instead of sending them out to work and earn. They will be like the green salesman who reported that he 'almost' got a big order, never quite competent, never quite ready for emergencies, and in fact never quite anything at all.

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# REVIEW OF THE MONTH

THE outlook is distinctly brighter than it was thirty days ago. While the shock brought about by the war in Europe hardly has been diminished by the course of events upon the field of battle, nevertheless business in general is showing undeniable symptoms of taking up its course again. In the Pacific Northwest the wharves, warehouses, and grain elevators bulging with the crops of last summer are commencing to give up their burdens. It is stated that finances have been arranged so that payments are to be made in Toronto. Nothing could have a more beneficial effect than the moving of the grain crop, as all of us have been looking for relief from the depression that has prevailed all summer to the money made available through the unusually bountiful harvest. Money is somewhat easier, due probably to the scolding administered to the bankers by the Secretary of the Treasury.

THE emergency shipping bill, passed in a hurry a month or so ago when a realization of our helpless condition as regards ocean freight traffic became apparent, has thus far failed to accomplish its purpose. The plan advocated for the purchase by the Government of a number of Hamburg-American liners lying in New York harbor called forth a prompt protest from Great Britain. Similar attempts on the part of private parties to change the registry of a number of British vessels has resulted in protests from Germany, all of which are natural under the circumstances, as the neutrality of the United States in the present conflict prevents any act on the part of the Government or private individuals that will provide any of the belligerents with funds. So we are no better off than before as far as shipping is concerned. Just what can be done to make the shipping law effective so far as a resumption of American trade is concerned, we do not know. The movement of our crops by way of Canada has already started, and as Great Britain has thus far retained her mastery of the seas, the congestion in this respect is being done away with and money will soon be flowing into the coffers of the farmer and his friend, the country banker.

THE dove of peace, which has been hovering about Mexico for the last few weeks, seems to have fled in dismay. General Villa, viewing with alarm the apparent tendency on the part of General Carranza to perpetuate himself in office after the approved Diaz-Huerta style, has declared his opposition in no uncertain terms. Most of us will be inclined to agree with General Villa that the establishment of a military man as president of the long suffering republic would send 'glimmering' any chance for the exercise of the theoretical constitutional prerogatives of the citizens. On the surface, General Villa, in spite of his history, seems to be the least selfish of the various leaders, and it is to be hoped that if he means what he says, that he may win his point without further bloodshed. Orders sent to General Funston for the evacuation of Vera Cruz have been temporarily recalled, awaiting the next move on the checkerboard.

A PLEASANT reminder that not quite all of Europe is engaged in killing and destruction is furnished by the arrival in San Francisco bay of the Diesel motor vessel *Kronprinz Gustaf Adolf*, sailing under the flag of Sweden. This vessel is under charter to W. R. Grace & Company and was built by Burmeister & Wain at Copenhagen, the builders of the Diesel-motor vessel *Siam* which recently visited Pacific Coast ports. The *Gustaf Adolf* is 362 feet in length, 51 feet beam, 25 feet draught, and has a cargo capacity of 6500 tons dead weight. She sailed from Hull on July 10 with a cargo consisting principally of pig iron and coke destined for San Diego, Los Angeles, and San Francisco.

AMONG the many interesting and instructive exhibits planned for the Petroleum section of the Panama-Pacific Exposition is a metal 'peg' model of the entire Sunset-Midway oilfield of California. This is being prepared under the auspices of the Kern County Oil Protective Association by Mr. E. B. Latham, chief geologist, and his staff. The research work and preventive measures taken by the Association toward the prevention of water encroachment in the oil sands has led to the compilation of a vast quantity of statistical data on the geologic structure of the district. The data already on hand are sufficient for the construction of the stick model without further field work. It is hoped that the construction and exhibition of this model will result in the construction of similar ones for other fields, and that oil men in general will realize the advantage of this opportunity of bringing before the general public data in such form as will result in a keener appreciation of the significance of petroleum production.

A RAY of sunshine has penetrated the gloom that for some time has clouded the situation of public utilities in California. In a decision handed down by the United States District Court in the case of the Kern Trading & Oil Company and the Associated Oil Company against the California Railroad Commission, an injunction has been issued restraining the latter from enforcing the penalties imposed by the State Act

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of June 4, 1913, that makes all owners of pipe-lines common carriers. The judges state that the penalties imposed by the act are excessive, and virtually amount to intimidation. The court, however, while retaining jurisdiction, refuses to pass on the constitutionality of the act, leaving this question for the state courts to decide, and until this phase of the matter has been finally adjudicated, the ultimate status of the act will remain unsettled.

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AMERICANS at peace with the world, will nevertheless have to pay war taxes. Territorial boundaries are of little significance nowadays. Transportation and means of communication are so rapid and efficient that we have become one big family, with the occasional family row to add an air of verisimilitude to the comparison. In order to make good the deficit in Government revenues due to the stoppage of imports from the nations at war, the House caucus has agreed upon a revival of the Spanish war tax on commercial and legal papers, bankers, brokers, theatres, a tax of 2 cents per gallon on gasoline, and a special tax on tobacco manufacturers and dealers, domestic wines and beer. This schedule is estimated to produce $105,000,000. The California wine manufacturer and grape grower will feel that he is between the devil and the deep sea. The voters of the state are to pass upon a 'dry' law for the entire state at the November election. This, to which is added a tax of 20 cents per gallon on sweet wines and 12 cents on dry wines, seems to make the wine producers lose whichever way the wheel of fortune should turn. Prohibition propaganda is flooding the country under the auspices of the same misguided sentimentalists who denied to the enlisted man of the army the canteen within the reservations and sent him instead to the groggeries of the slums. George Fitch once said that the liquor habit was an excellent thing, as it made so many good jobs for the man who did not have it. We are inclined to hold with Mr. Fitch on this question, and believe that intemperance is gradually settling itself by a cleaner living people who are becoming educated up to the belief that any overindulgence that impairs efficiency is not to be tolerated. One can not legislate morals into a people; education is the only way.

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OIL production, contrary to expectations, has shown a decided increase. For the month of August, the first month of the European war, the production was 9,034,853 barrels, an increase of about 65,000 barrels over the preceding month, or about 2000 barrels per day. As shipments dropped off some 300,000 barrels, or 12,000 barrels per day, the result is a corresponding increase in stock on hand and a much less favorable situation with respect to the producer. The Standard Oil Company, which has in the past been very liberal with producers in regard to shipments in excess of amounts called for, has served notice on all producers with whom it has contracts that no amounts of oil will be received in excess of the exact quantities called for. In the meantime, the Company has abandoned for the time being many increases in equipment planned before the war and is putting the amounts appropriated into extra tankage in which to store the excess of oil over that for which it can find a market. The present condition works a greater hardship on the refiner and marketing concerns than on the more fortunate holders of time contracts which take no account of a condition that has all at once deprived the vendor of the foreign market for both refined and crude products. It is noteworthy that the only measures taken by the Standard Oil Company to protect itself have been to insist upon the observance of the letter of the contracts as regards quantities, and that the 'Act of God' clause found in most contracts has not been invoked as a reason for their cancellation.

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PLANS have been filed with the San Francisco Board of Supervisors by the city engineer, Mr. M. M. O'Shaughnessy, for extensions to the municipal street railway system aggregating 89 miles in length and estimated to cost approximately $9,000,000. A road is proposed across Golden Gate park and thence to the ocean beach and Sloat boulevard, 8.8 miles in length. Another road is proposed to connect with the Geary-street line at Masonic avenue and to cross Golden Gate park into the Sunset district, 13.2 miles long. Other proposed routes are from Potrero avenue to Hunter's point, 8.5 miles, on Market street from Geary and through the Twin Peaks tunnel, 7.9 miles, and from Geary street and Thirty-third avenue to the Cliff house, 6.4 miles. The cost will be approximately $100,000 per mile, the extensions named being in addition to those for which bonds have been voted.

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PREPARATIONS are being made by the Board of Public Service Commissioners of Los Angeles to serve all the city with water from the Owens River supply. William Mulholland, chief engineer for the commission, has been instructed by the Board to secure data concerning all of the privately owned companies, of which there are eighteen, now operating within the city. The city has already offered $470,000 for the Union Hollywood company, which is larger than all the others combined, and it is stated that a number of the others can be taken over without cost to the city. The vacant-lot assessment plan is favored by the Board as a means of providing funds for the various purchases necessary, and the matter is to be brought before the City Council, with whom the decision rests. Much unfavorable criticism has recently been directed at the quality of the Aqueduct water, and while in the absence of confirmatory data as to the merits of the contentions of the critics, it is well to refrain from comment, it would appear on the surface to be no more than another of the many attacks that have been made upon the Aqueduct from time to time and emanating from political sources. The harmony among the 'Angelenos' is sometimes a discord.

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# Methods and Costs of Constructing B Street Bridge, Hayward, California

By R. W. WHITE *

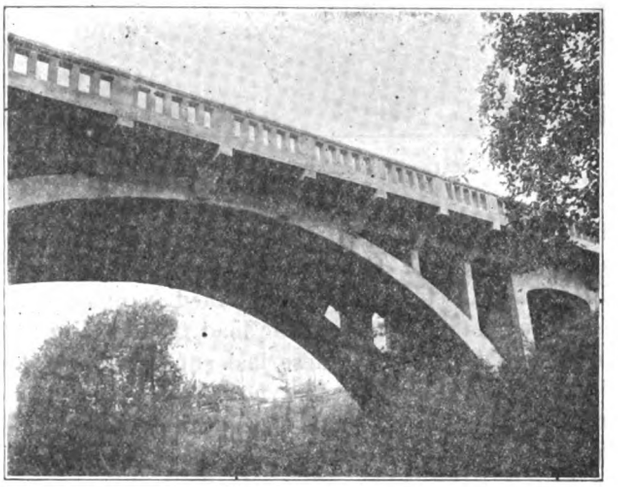
During the past few years a marked progressive movement has existed in Alameda county relative to good roads and permanent structures. In almost every case where old structures have had to be removed, either because they were insufficient, or had become weak and defective, they have been replaced by permanent concrete or steel structures.

The old bridge on B street, Hayward, which is the main highway from Hayward to the Dublin boulevard, was a combination through Howe truss of 140-ft. span resting on pile piers, with a pile bent approach 33 ft. long on the north and 15 ft. long on the south. The timber members had become badly rotted and the steel very rusty. In the latter part of 1912 it became necessary to condemn the bridge and close it to traffic. About the same time the Board of Supervisors directed P. A. Haviland, county surveyor, to prepare plans and specifications for a permanent structure at this point. The necessary surveys were made and test borings taken to determine accurately the type and location of the bridge.

The type decided upon was a reinforced concrete open spandrel ribbed arch bridge. The bridge as constructed is of reinforced concrete with a 90-ft. arch span and an 18-ft. girder span at each end. The arch span consists of two parallel ribs 6 ft. wide and 13 ft. apart. These two ribs support spandrel columns which carry a deck slab. On this deck is a 2-ft. gravel fill for roadway 24 ft. wide. At the shore ends of the girder spans are cross-walls supported by buttresses which rest on the arch rib abutments. Back of the buttresses on the banks are curved wing walls. A 4-ft. sidewalk and ornamental parapet is supported at the sides of the roadway by brackets at the top of the spandrel columns. The parapets curve away from the centre line of the bridge at the wing walls and give a wide and graceful appearance to the approaches.

Four pits were excavated for the abutments, which were to be 6 ft. wide. When these pits were nearly completed it was desirable to shift the location of the bridge down stream 1.4 ft. As the pits were excavated to the neat line of the abutments, and as we required these pits to be solidly back-filled with concrete, the footings were necessarily 7.4 ft. wide instead of 6 ft. The bottom 4 ft. in all pits was excavated in sand rock, this depth being necessary to insure a rock of good bearing power and also to get below the erosive action of the stream. The stream was dry at the time the pits were excavated and the only water encountered was handled by a 2-in. centrifugal pump.

A one-half cubic yard batch mixer was placed on the centre line of the bridge at the south bank and concrete was handled from the mixer in two-wheel carts. Wherever possible, chutes were used directly from the mixer. Concrete was composed of Santa Cruz portland cement, one part by volume of cement to six parts of aggregate of creek and crushed gravel. The creek and crushed gravel were in proportions to give the densest mixture. Screened samples were measured from time to time to test the relative proportions of fine and coarse aggregate.



VIEW FROM BELOW OF COMPLETED BRIDGE.

Abutments were poured, filling the excavated pits solid with concrete after removing the water with a hand pump. The top surface was stepped with the back part higher than that toward the stream. The next concreting finished the abutments for a width of 6 ft. and to elevation 72, with a 3-ft. recess at the back for the buttress and two steps in the face for a seat for the ribs. All arch centres and arch reinforcements were in place at this time.

Arch centres were founded on 12 by 12-in. sills resting on the rock of the creek bed. On these sills were posts about 8 ft. long made of the old bridge piles. There were three rows of piles under each rib and two between the ribs. There were six bents in the span at about equal spaces. The piles were capped with 4 by 12-in. old bridge stringers. These caps were set as near the same level as practicable and extended across the bridge. Over these caps and running lengthwise of the rib were six lines of 4 by 12-in. timber, arranged to come directly over the piles which were under the ribs. Resting on these last pieces were 16-in. Oregon pine wedges directly over the piles. Over from the wedges, which were directly over the piles, and extending across the bridge were 4 by 12-in. timbers, on

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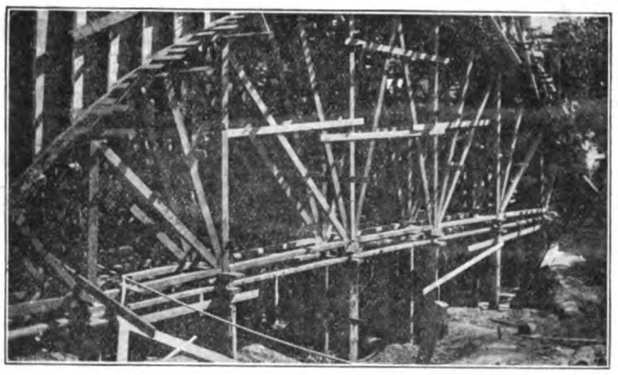


MAIN ARCH CENTRING AND FORMS.

which were set the 6 by 6-in. vertical posts, there being one over each pile. These posts were capped with 4 by 6-in. timbers. Intermediate inclined supports were placed so that they carried the load from the circle to the foot of the posts. These last supports were 4 by 6-in. timbers and as nearly normal to the intrados curve as possible. The caps were put about 5 ft. apart. There were 4 by 6-in. horizontal struts lengthwise of the bridge between the foot of all verticals and between the verticals and ribs near the haunches. As soon as the vertical centres were capped, the wooden circles were raised in place. There were five of these wooden circles in the 6-ft. width of rib. They were constructed of two pieces of 2 by 10-in. timbers spiked together to half lap. They were sawed at the mill to the proper curve and spiked together on the ground. The curve of the centres was checked by coördinates. The side forms for ribs were constructed of 1 by 6-in. horizontal sheathing with 2 by 4-in. and 2 by 6-in. vertical studs at 2-ft. centres. A 1 by 6-in. ribbon was run over the lagging of the centre to hold the side forms where it intersected the lagging. A 1½ by 1½-in. triangular strip was put in the corner of the lagging and side forms to chamfer the corner of the intrados of the ribs.

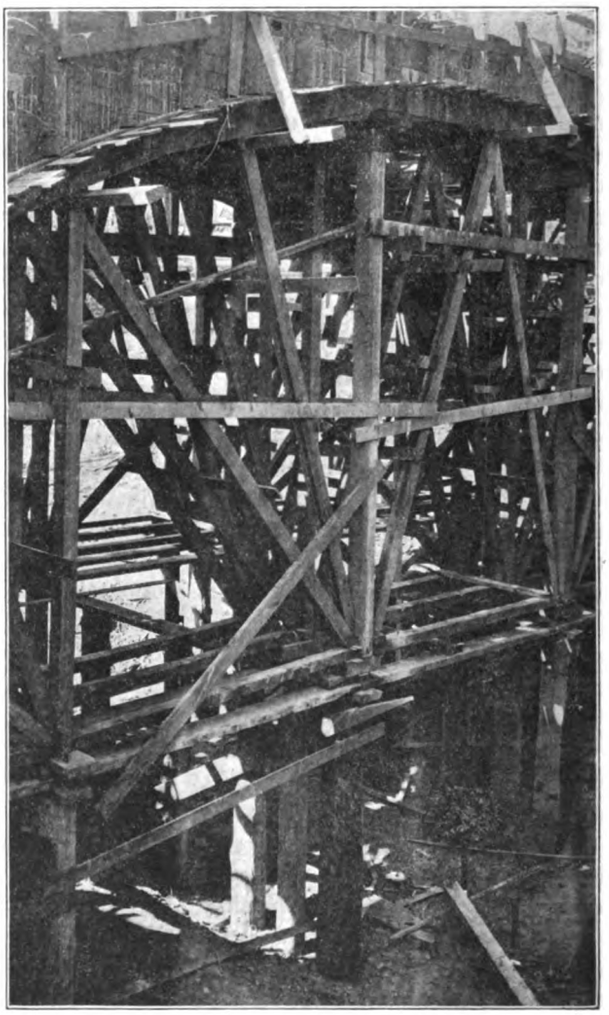
The design of the centres was submitted by the contractor to P. A. Haviland for approval. Several additions were made and the centres were built according to the corrected design. In future design of centres for this kind of arch, the caps over the piles should be arranged to come directly below the floor beams to facilitate forming them. Also, the caps should be of heavy timber. The wedges should be of some harder wood than Oregon pine with a smaller bevel and well greased. All caps should be of same elevation and all centres should be framed before erection to insure tight joints.

Back forms for the ribs were made by running 2 by 4-in. timbers across the rib at 2-ft. centres and springing the sheathing to the curve of the extrados. This is an unsatisfactory method, as it is very difficult to get the proper curve and to maintain it during concreting. The sheathing necessarily has to be placed previous to concreting, and walking on the forms, as is necessary during the construction and concreting, pushes the sheathing from the 2 by 4-in. pieces. It would have been far better to have sawed circles running lengthwise of the rib and then to have placed the sheathing as the concreting progressed.

The columns at the arch ribs were formed up for about a foot to give a square and firm bearing for the column and column forms which were built later.

The concrete was poured through the openings at the column stub. Concrete was poured on alternate sides of the crown up to the column stub. This alternate pouring equalized the loading on the centres. The abutments had been concreted several days in advance of this work and held the centres rigidly. The extrados curve was checked by coördinates every few minutes during the concreting and the upward rise of the crown watched carefully. Concrete was poured from carts on a scaffold built between the ribs. Chutes directed the concrete into column openings. In order to do tamping and inspecting during concreting, it was necessary to open pockets in the side forms of the rib. These pockets were closed as the concreting progressed. The rib from abutment to abutment with column stubs weighed approximately 129 tons.

The arch ribs were reinforced in the extrados and



VIEW SHOWING CENTRING UNDER MAIN ARCH AFTER POURING CONCRETE.

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intrados with 1⅛-in. square deformed bars spaced at 6-in. centres with ⅜-in. stirrups around two extrados and two intrados bars in pairs. These stirrups were spaced at 24-in. centres and ½-in. bars were placed across the rib at 24-in. centres to space the main reinforcement of the intrados and extrados.

Concrete blocks were cast to hold the steel from the forms. There were cast in strips and broken into desired lengths, and battered on the sides to assist in keying them into the concrete.

All steel consisted of square deformed bars. This steel was more easily held in place than a square twisted bar. Bending was done by hand with pins in a 12 by 12-in. timber as a fulcrum and a pipe over the bar as a lever. The beam reinforcement, wherever possible, was assembled and wired together and put in the forms as a unit. Cutting lists showing bends, etc., were provided by the firm furnishing the steel to the contractor.

The back forms for buttresses and cross-wall were built first. The steel was then placed and the front forms built last. Pockets for inspection and tamping were provided on the batter faces of the buttresses. These forms were constructed of 2 by 4-in. studs with 1 by 6-in. horizontal sheathing and securely wired at 2-ft. intervals with No. 10 wire. The concreting was done from the top after the floor forms were completed and extended up to the bottom of the longitudinal floor beams. Plank runways for the carts were laid on the floor forms.

The column reinforcement was held rigidly by the concrete in the arch ribs and the column studs. These studs formed a guide and firm support for the column forms. The studs rested on the arch rib and were capped with 4 by 6-in. timbers at their tops to carry the 2 by 5-in. floor joist. The columns and top haunches were concreted to the bottom of the floor beams. Bulkheads were placed in bracket forms.

The forms for the soffit for the curved beams were built on two centres composed of two pieces of 1 by 12-in. plank half-lapped and sawed to the proper curve at the mill and sheathed with 1-in. sheathing. These curved beams and the two longitudinal beams near the centre of the roadway were supported by two pieces of 4 by 6-in. timbers running lengthwise of the beams. These 4 by 6-in. pieces were supported at the ends and centres by posts from the ground or arch rib.

The inclined intermediate support in the arch centre were removed and this lumber used for floor forms. The longitudinal 2 by 6-in. floor joists at 2-ft. centres rested on two 4 by 6-in. caps on the column studs. At the edge of the rib toward the centre line of the bridge these studs were doubled and 4 by 6-in. caps spanned the 13-ft. space between the ribs and carried the floor joist at the centre of the roadway. The caps were doubled and 2 by 4-in. beam hangers were spiked to the joist. A 1½ by 1½-in. triangular strip was put in the forms to chamfer the edges of the beams and haunches. Supports extending from the ground to the floor beams supported the 4 by 6-in. cross-beams at the centre of the bridge.

The floor was concreted as follows: The two end sections or girder spans were concreted in one day. The deck was bulkheaded at a point 2 ft. beyond the cross-girders at sections B B. This was necessary as the girders were calculated, including the deck slab, as a compression flange. The following day the deck between sections B B and E E at both ends of the bridge was concreted. The bulkhead was put in as before at a little past the beams at section E E. The third day completed the concreting of the floor system.

The brackets were formed over the sides of the bridge and concreted when the floor was concreted. A recess was left at the outer ends to receive the sidewalk beam. The curved face was formed on 2-in sawed ribs. The brackets were supported on the column studs and the outer ends were held up by angle braces to the arch ribs.

The steel for the sidewalk was placed before the deck was concreted. Sidewalk joists were run between the bracket forms. A 4 by 6-in. timber between the brackets supported the sidewalk beams. On the long spans the 4 by 6-in. timber under the sidewalk beams was supported from the ground at the centre. The brackets had been concreted some time previous to the erection of the forms for the sidewalk and the studs at the sides of the bracket forms were well wired through the bracket. The weight of the sidewalk beam and slab was carried on the bracket form. The 10 by 10-in. opening through the brackets for pipes and wires formed an excellent support for the sidewalk joist next to the vertical outside curb wall form. Two pieces of 2 by 4 in. on each side of the top of the sidewalk beam formed the reveals at the bottom of the openings in the parapet. The sidewalk beam and slab and curb wall were concreted at the same time the sidewalk was finished with a ⅜-in. top surface, darkened with lampblack and marked off into squares. A ⅜ by 3-in. steel curb guard was put on the curb walls. The bridge has a camber of 6 in. in half its length.

The north wing walls are designed to resist the earth pressure as a vertical slab supported by heavy vertical beams or buttresses on the inside of the walls. The tops and bottoms of these buttresses are tied together across the bridge by 12 by 18-in. tie beams. The tie top beams were supported by 12 by 12-in. columns. The footings were found to be of soft material at the depths indicated by the drawings. A footing of 3-ft. width and an average depth of 3 ft. was put below these wing walls.

The tie bottom beams next to the cross-wall were constructed in a trench in the bottom of a tunnel dug between pits for the columns and the wing wall trenches. The excavated material was worked under the cross-wall and used in backfilling the north abutment pits. The second bottom beam was concreted in an open trench dug between the wing wall trenches and the trench backfilled by the excavated material

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from the trench for the third or north lower tie beam. After these ties, footings, and columns were concreted, the walls and buttresses were concreted to the top of the top tie beams, at one pouring. The horizontal wing wall reinforcement had been previously bonded into the buttresses at the ends of the bridge. The next concreting completed the remaining section of wall, sidewalk retaining slab and the curved sidewalk beam to the bottom of the opening in the parapets. The top tie beams were concreted last.

The south wing walls are designed as gravity walls beyond the curved part. The curved part of these wings is designed as an arch between the end of the gravity wings and buttress at the end of the bridge. The footings 18 in. high were concreted on these wings and the forms erected on these footings. The next concreting completed the walls, including the sidewalk retaining slab and the curved sidewalk beam to the bottom of the openings in the parapets.

After the forms had been stripped from the entire structure, the balustrade and outer surfaces of the arches and spandrel columns were finished with a cement plaster, leaving the entire surface in a clean and smooth condition.

The following table shows the unit costs for the construction of the B street bridge.

| | |
|---|---|
| Excavation for foundation | $0.75 per cu. yd. |
| Excavation for fill | 0.25 " " |
| Concrete | 9.00 " " |
| Reinforcing steel | 0.05 per lb. |
| Curb guard | 0.25 per lin. ft. |
| Cement paint | 0.25 per sq. ft. |
| Gravel for roadway | 1.50 per cu. yd. |
| Asphalt paint | 0.01 per sq. ft. |
| 3 by 12-in. redwood curbing | 0.11 per lin. ft. |

The total cost of the structure, including the removal of the old bridge, the grading of a portion of the roadway adjacent to the northerly end, together with the necessary culvers and curbing was $16,200.

## THE PROBLEM OF MOTOR GASOLINE

By JOHN WINKLER

California petroleum is one of the large sources for gasoline, and yet probably 80% of it is too thick for any explosive mixture and a sootless burn in the cylinder. To depolymerize the heavy hydrocarbon oils down to their simplexes—somewhat analogous to the depolymerization of synthetic rubber back to isoprene—the following experiments were carried out:

**Effect of Corona.**—A glass tube 2¼ in. diameter by 3½ ft. long, wrapped with wire gauze, with a ¼-in. copper rod suspended co-axially through its centre, was used as a hot vapor chamber, while at the same time the inside rod and outside gauze were kept at a potential of from 25,000 to 30,000 volts by dynamo and high potential transformer. When the room was darkened a continuous bright bluish glow was evident throughout the tube, that is, a corona. Through this glow (air removed) various California heavy distillates were distilled repeatedly, with a large excess of hydrogen (dry and moist), the object of the corona being to ionize the hydrogen. Practically no change could be detected in the oils after repeated slow distillations through the above chamber.

**Effect of Arc.**—The Birkeland-Eyde process was applied to these oils in an atmosphere of hydrogen. The oils, both liquid and gaseous, were passed through with increasing speed, to shorten the time in the arc. The carbons were hollow, and hydrogen was passed inward through both. They were kept cool by a water jacket. The results were variable, but in every case the oils were reduced to non-condensable gases and a cloud of fine carbon.

**Effect of Steam and Aluminum Under Pressure.**—Very fine aluminum dust was mixed with various heavy California oils to a 'suspension' and these mixtures subjected to a pressure of 110 lb. per square inch with steam in a heavy, specially constructed machine. They were also agitated, and at the same time heated to various temperatures (indicated by thermometer) up to their cracking points. The purpose of the aluminum and steam was to generate nascent hydrogen within the oil. A variety of attempts indicated no success. The aluminum was not amalgamated.

**Effect of Reduced Nickel Oxide and Hydrogen on the Aerated Oil.**—According to Charitschkoff, better results at 'cracking' Russian petroleum were obtained by first oxidizing the oil. Heavy California oils were heated, and aerated (by drawing air through them) for two or three days, to oxidize them and to generate petroleum acid (the purpose of this oxidation also being to introduce carboxyl groups, with the possibility of splitting out water with the hydrogen afterwards, and leaving the rest of the broken molecule to unite with the excess hydrogen). The aerated oils were subjected to the now well known hydrogenating process of reduced oxide and hydrogen (said to be least sensitive to sulphur compounds), but without success. Iodine was substituted for the nickel oxide with no better results.

**Effect of Rhodium Black and Hydrogen.**—First, active platinum black, made according to the Loew process, has been shown to be a good catalyst to hydrogenate pure benzol and pure benzine. It is, however, poisoned by sulphur bodies. The work was corroborated in this laboratory perfectly, but California oils contain sulphur, and so do not hydrogenate.

Second, G. Bredig has shown that rhodium metal acts as a catalyst to break down formic acetic acid to H and $CO_2$, etc., and that sulphur bodies are favorable to its activity. Rhodium black was made (by the Loew process), and tried out on California oils under parallel conditions, but failed to hydrogenate in the least.—*Journal Franklin Institute.*

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# Locating and Estimating Highways*

By F. W. ALLEN†

There is one unfortunate thing that confronts the engineer very often. That is, when trunk highways are surveyed by order of petition, the petitions are often so worded as to give an engineer no opportunity to use his best judgment as to the proper location of the road, and should he deviate from this, it generally meets with strong opposition from the petitioners. On the other hand, a great many petitions or orders from those in authority are left to the best judgment of the engineer.

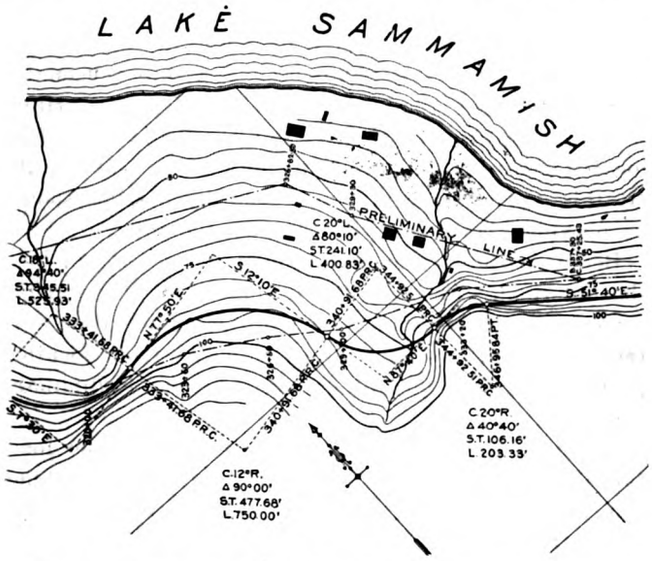


FIG. 1. EXTENT OF TOPOGRAPHY AND PRELIMINARY OVER OLD ROAD WORK.

If a careful investigation were made when surveying a road, it would greatly influence the class of location selected. Many cases may arise where a short piece of road is desired, which, if properly located, might be used as a unit for some future trunk highway by extending from one or both ends. If it is certain, or even possible, that a highway is to be surfaced, it should have a considerable influence upon location and class of roadbed to be adopted.

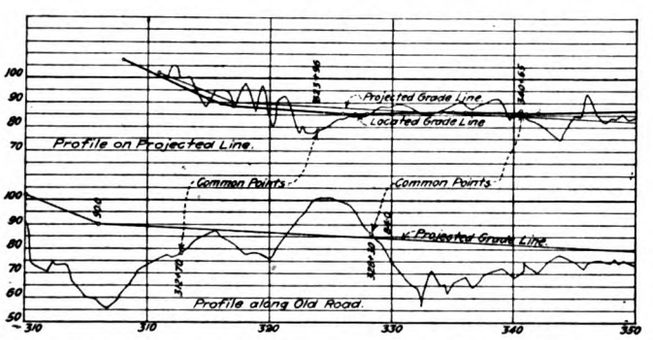


FIG. 2. FINAL PROFILE, SHOWING ALIGNMENT NOTES AGREE WITH PROJECTIONS ON MAP.

Thoroughfares radiating from a commercial centre or connecting two or more towns, should always be treated so that, when locating and constructing an earth or gravel road, there will be no additional grading due to a change of alignment or change of grade, should it be desired to hard surface in the future.

### Cost and Influence of Surface Roads

The public is beginning to demand that only the very best types of surfacing shall be used in the pavement of permanent highways. Governor Glynn of New York has ordered that all highways hereafter shall be paved with brick on a concrete base, providing convict labor is used in the manufacture to reduce the cost. Even under these conditions the first cost will probably exceed the bituminous and other types of pavement by several thousand dollars per mile. In the Northwest, brick pavement on highways costs between $24.000 and $27,000 per mile; various other types ranging from $10,000 to $21,000 per mile in cost.

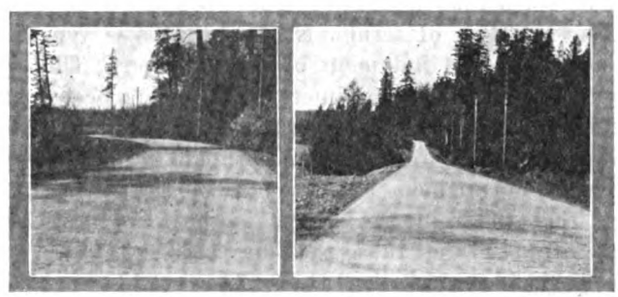

FIG. 3 AND FIG. 4. PACIFIC HIGHWAY NEAR BOTHELL. MINIMUM SIGHT DISTANCE ABOUT 250 TO 300 FEET.

In the selection of type of pavement, due consideration should be given to the probable future traffic as well as the present, and the pavement selected should outlast the life of a bond if improvement is being paid for by that means. The permanent highway law of Washington takes care of nearly all pavement improvements. One clause of this law states:

"The term 'permanent highway,' when used in this chapter, shall be construed to mean an improved public road constructed along a main line of travel, either beginning at some trade centre or an extension of an existing road of like character beginning at some trade centre. Every permanent highway shall be uniformly graded to a width of not less than 16 ft., shall have proper bridges, drains and culverts, and shall be surfaced with macadam, stone, gravel, or other material equally as permanent and durable not less than 12 ft. in width. No such highway shall be constructed with a

*Read before the Pacific Northwest Society of Engineers, June 19, 1914.

†Deputy County Engineer, Seattle, Washington.

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FIG. 5. NEWPORT ISSAQUAH ROAD.
FIG. 6. ROAD TO PRESTON, SHOWING CEDAR LOG BULKHEAD.

grade exceeding 5%, except where, by reason of physical conditions, it is not feasible or practicable to obtain such a grade, but in no case shall any such highway be constructed with a grade greater than 10 per cent. (L. '11, ch. 35 & 1; Re.-Bal., & 5879-1; Pierce's Code 1912, 441 & 207.)"

## Reconnaissance

Highways should be treated like railroads. The question of selecting a proper route is essentially an economic one, involving not only first cost of construction, but probable cost of maintenance, together with what will be a justified expenditure for the future traffic when road is constructed.

The selection of terminals of highways is very seldom left to the judgment of the engineer. The one problem that is given him to solve is the best route between these points or best available grade by a given route. A reconnaissance should be made over an area, not a line. The engineer should satisfy himself that the route he selects is the very best, and carefully study all those that may seem inferior. Too much haste means either a poor line or additional cost for preliminary survey. No amount of notes or topography can take the place of personal knowledge of all conditions and problems to be encountered.

The preliminary surveys are of much more importance than the average engineer considers due this portion of the work. It is much cheaper to run a careful preliminary or probably several, than to make a trial location, as is often practiced by railroad locating engineers. There are several authorities whose opinion is that for railroad location too much care on preliminary is a waste of money, and a location should be adjusted from a trial. An engineer's best judgment should be displayed in the preliminary survey he makes rather than the final location. The preliminary should be as close as possible to the final location, so that the error in taking topography is the minimum.

Topography should be taken when it can be fairly accurate, and no farther. Should it develop that the projection would extend beyond this point, it is by far better to run an additional preliminary rather than try to extend the topography. As much care should be taken in mapping a preliminary as possible. Coördinating angle points is the ideal way, even if it may seem to some a little too close for projection purposes.

The projection should be carefully made, giving this feature of work very close attention. There is as much room for good judgment in projecting a line as in running a good preliminary. Again it is policy to coördinate the points of intersections. This method gives the engineer an opportunity to see where any errors are, before locating the projection on the ground. There is no reason, if a preliminary and projection is carefully made, why the location notes on the ground should not correspond with those previously made on paper.

Sharp curves and adverse grades should be avoided whenever possible. It often develops in this part of the country that this is impossible within reasonable construction for road purposes (see Fig. 3). Highways, like railroads, when in rough country should be located on supported grade to obtain the best results. By this is meant as uniform a grade as possible should be obtained between two controlling points.

Below is shown the preliminary *B* line as run over the old road. Above is the profile as taken from the topography in relation to the projected location with the final grade as determined in office from location profile, and the projected grade from preliminary survey.

Above is the final profile as determined from location and grade line and balanced in office for construction. This is a fair comparison between projection profile and locator's profile.

A safe sight distance should always be obtained wherever possible. Opinions differ as to the amount of this distance, varying from 250 to 500 feet. Tests show that an automobile running at a rate of 20 miles per hour can be stopped within 140 ft. All

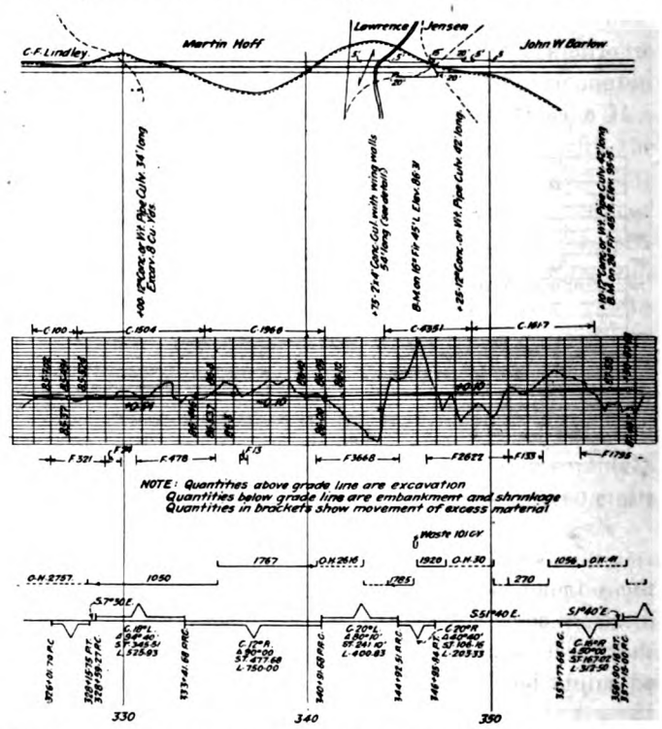


FIG. 7. PRELIMINARY B LINE, FINAL GRADE, AND PROJECTED GRADE, FROM PRELIMINARY SURVEY.

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highways being constructed today allow sufficient passing room, so that dead stop is not often necessary, merely a slow-down sufficing. Under these conditions, it seems that 150 to 200 ft. of sight should be ample for the fastest traffic. Always bearing in mind that highways are not speedways, even though often used as such, 250 ft. of sight would require a minimum curvature in alignment of 28° where roadbed is 24 ft. in width and slopes in excavation are one to one. This would be prohibitive on nearly all roads in this part of the country, so it is the duty of a driver to slow down on all curves. A tangent from 50 to 100 ft. in length between all reverse curves is always desirable for good locations. This should always be obligatory unless it increases an already sharp curve too

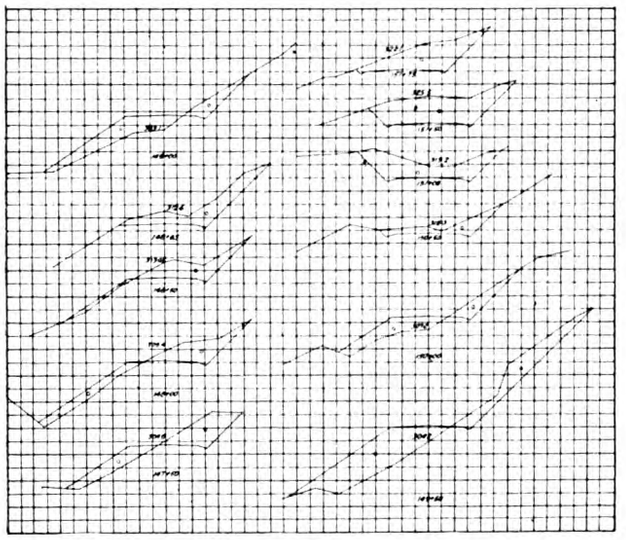

FIG. 8. PLOTTED CROSS-SECTIONS OF ROADBEDS.

materially. A flat curve is always preferable to short tangent and sharp curves. Where highways are to be paved, a short tangent between curves becomes almost a necessity on sharp curves, because the starting point for super-elevation of the outer edge of pavement for curve should always be on tangent such a distance from the point of curve as to allow a gradual rise. In case of reverse curves, an unsightly and often dangerous warp in the surface is obtained by trying to elevate the outer edge of the pavement.

There is no great amount of skill necessary in locating on the ground if all the preliminary work is properly performed. It is only a mechanical process of staking a line on the ground with notes previously prepared. There are cases where error in topography or preliminary will cause a revision on the projection notes. These cases require more or less good judgment in readjusting. If care is taken in the preliminary, those conditions will never arise.

One of the most important features of location is securing all the information possible that influences the grade line, watercourses, classification of soil, and timber and all high-water marks. The judgment of the engineer on location is best shown by the cross-sections taken both in distance out and proper places and breaks.

Laying the grade line can only be done approximately in the field. The locator should not neglect this point, but lay a grade to the best of his judgment, noting all the controlling features of a gradient. The final grade line is purely an office job, and should not be guessed at for construction purposes, for reasons given in later paragraphs. The maximum grade, as well as eliminating all the adverse grade possible, should always be on the mind of those balancing a grade line. For sightly reasons, if no other, grades should be broken on curves wherever possible. The maximum grade in the state of Washington is 5% for all permanent highways, as stated in previous paragraphs.

Following is a list of ruling grades adopted by several states and in Europe:

RULING GRADES IN FOREIGN COUNTRIES

| | Mountainous districts, %. | Hill districts, %. | Level districts, %. |
|---|---|---|---|
| Prussia | 5 | 4 | 2 |
| Hanover | 4 | 3⅓ | 2 |
| Baden | 8 | 6 | 5 |
| Brunswick | 5 | 4 | 3 |
| Holyrod road in England | 6 | 3 | .. |

Military highway over the Alps: Italian side, 4½%; Swiss side, 6%.

France: National roads, 3%; department roads, 4%; subordinate roads, 6%.

RULING GRADES IN THE UNITED STATES

| | Main roads, %. | Side roads, %. |
|---|---|---|
| New York | 5 | 7 to 8 |
| Massachusetts | 5 | 7 |
| Connecticut | 5 | .. |
| New Jersey | 5 | 6 to 7 |
| Michigan | 6 | .. |
| Missouri | 5 to 6 | .. |
| Washington | 5 | 5 |
| Illinois | 6 | .. |

It will be noted that the steepest grades in Europe are to be found in Baden.

It would be impossible to discuss in this paper the question of tractive power on the different grades. For comparative purposes, to illustrate the necessity for reducing grades to a minimum, the following are the approximate loads in tons for one team on different grades for improved roads and permanent surface: Level, 7 tons; 2½%, 6 tons; 3%, 5.1 tons; 4%, 4.2 tons; 5%, 3.3 tons; 6%, 2.6 tons; 7%, 2 tons; and 10%, 1.3 tons.

No reliable comparison could ever be compiled for earth or gravel roads, as no two conditions are ever alike.

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### Office Work

It should always be borne in mind that the most economical grade is one in which the embankment and excavation balance. A trial grade should first be laid on the profile, observing all the controlling features as laid down by the men in the field. This is best accomplished by determining the elevation on the cross-section where the cut will equal the fill, and plotting these elevations on profile; thence producing a gradient through these points balancing cuts and fills to the best advantage.

After this is done the grade should be noted on the plotted cross-section (cross-sections being plotted in relation to elevation). A celluloid templet of the roadbed with one side in excavation and one in embankment is then used to draw in the road section proper, conforming to the trial grade.

The cross-sections, Fig. 8, show the final grade of roadbed as drawn in relation to elevation of section. The circle indicates the approximate units of gravity of section, and figures at the intersection of centre line and ground line refer to elevation of ground at that point. A reliable polar planimeter is accurate enough to measure these sections, and much quicker than figuring them. A good planimeter should be read within ½ to 1% on small areas, and decrease as size of area increases by traversing outline twice or more and taking mean reading. The area thus obtained should be noted in some convenient form of record (see Fig. 9), and the sum of areas being noted from which corre-

FIG. 11 AND FIG. 12. CONDITION OF GROUND AFTER CLEARING, AND COMPLETED ROADBED. NEWPORT ISSAQUAH ROAD.

FIG. 13. ROAD TO PRESTON, SHOWING DIFFICULTY IN MAINTAINING STANDARD SIGHT DISTANCE OF NOT LESS THAN 250 FEET.

| Areas. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Contents. | 0·2 | 0·3 | 0·5 | 0·7 | 0·9 | 1·1 | 1·3 | 1·5 | 1·6 | |

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0·0 | 1·8 | 3·7 | 5·5 | 7·3 | 9·1 | 11·0 | 12·9 | 14·8 | 16·1 | 0 |
| 1 | 18·3 | 20·3 | 22·2 | 24·1 | 25·9 | 27·8 | 29·6 | 31·5 | 33·3 | 35·2 | 1 |
| 2 | 37·0 | 38·8 | 40·7 | 42·6 | 44·4 | 46·3 | 48·1 | 50·0 | 51·8 | 53·7 | 2 |
| 3 | 55·5 | 57·4 | 59·2 | 61·1 | 62·9 | 64·8 | 66·6 | 68·5 | 70·3 | 72·2 | 3 |
| 4 | 74·0 | 75·9 | 77·8 | 79·6 | 81·5 | 83·3 | 85·2 | 87·0 | 88·9 | 90·7 | 4 |
| 5 | 92·6 | 94·4 | 96·3 | 98·1 | 100·0 | 101·8 | 103·7 | 105·5 | 107·4 | 109·3 | 5 |
| 6 | 111·1 | 112·9 | 114·8 | 116·6 | 118·5 | 120·3 | 122·2 | 124·0 | 125·9 | 127·8 | 6 |
| 7 | 129·6 | 131·5 | 133·3 | 135·2 | 137·0 | 138·9 | 140·7 | 142·6 | 144·4 | 146·3 | 7 |
| 8 | 148·1 | 150·0 | 151·8 | 153·7 | 155·5 | 157·4 | 159·2 | 161·1 | 162·9 | 164·8 | 8 |
| 9 | 166·6 | 168·5 | 170·3 | 172·2 | 174·0 | 175·9 | 177·8 | 179·6 | 181·5 | 183·3 | 9 |
| 10 | 185·2 | 187·0 | 188·9 | 190·7 | 192·5 | 194·4 | 196·3 | 198·1 | 200·0 | 201·8 | 10 |
| 11 | 203·7 | 205·5 | 207·4 | 209·2 | 211·1 | 212·9 | 214·8 | 216·6 | 218·5 | 220·3 | 11 |
| 12 | 222·2 | 224·0 | 225·9 | 227·8 | 229·6 | 231·5 | 233·3 | 235·2 | 237·0 | 238·9 | 12 |
| 13 | 240·7 | 242·6 | 244·4 | 246·2 | 248·1 | 250·0 | 251·9 | 253·7 | 255·5 | 257·4 | 13 |
| 14 | 259·2 | 261·1 | 262·9 | 264·8 | 266·6 | 268·5 | 270·3 | 272·2 | 274·0 | 275·9 | 14 |
| 15 | 277·8 | 279·6 | 281·5 | 283·3 | 285·2 | 287·0 | 288·9 | 290·7 | 292·6 | 294·4 | 15 |
| 16 | 296·3 | 298·1 | 300·0 | 301·8 | 303·7 | 305·5 | 307·4 | 309·2 | 311·1 | 312·9 | 16 |
| 17 | 314·8 | 316·6 | 318·5 | 320·3 | 322·2 | 324·0 | 325·9 | 327·8 | 329·6 | 331·5 | 17 |
| 18 | 333·3 | 335·2 | 337·0 | 338·9 | 340·7 | 342·6 | 344·4 | 346·3 | 348·1 | 350·0 | 18 |
| 19 | 351·8 | 353·7 | 355·5 | 357·4 | 359·2 | 361·1 | 362·9 | 364·7 | 366·6 | 368·5 | 19 |
| 20 | 370·3 | 372·2 | 374·0 | 375·9 | 377·8 | 379·6 | 381·5 | 383·3 | 385·2 | 387·0 | 20 |
| 21 | 388·9 | 390·7 | 392·6 | 394·4 | 396·3 | 398·1 | 400·0 | 401·8 | 403·7 | 405·5 | 21 |
| 22 | 407·4 | 409·2 | 411·1 | 412·9 | 414·8 | 416·6 | 418·5 | 420·3 | 422·2 | 424·0 | 22 |
| 23 | 425·9 | 427·8 | 429·6 | 431·4 | 433·3 | 435·2 | 437·0 | 438·9 | 440·7 | 442·6 | 23 |
| 24 | 444·4 | 446·3 | 448·1 | 450·0 | 451·8 | 453·7 | 455·5 | 457·4 | 459·2 | 461·1 | 24 |
| 25 | 462·9 | 464·7 | 466·6 | 468·5 | 470·3 | 472·2 | 474·0 | 475·9 | 477·8 | 479·6 | 25 |
| 26 | 481·5 | 483·3 | 485·2 | 487·0 | 488·9 | 490·7 | 492·6 | 494·4 | 496·3 | 498·1 | 26 |
| 27 | 500·0 | 501·8 | 503·7 | 505·6 | 507·4 | 509·2 | 511·1 | 513·0 | 514·8 | 516·6 | 27 |
| 28 | 518·5 | 520·3 | 522·2 | 524·0 | 525·9 | 527·8 | 529·6 | 531·5 | 533·3 | 535·2 | 28 |
| 29 | 537·0 | 538·9 | 540·7 | 542·6 | 544·4 | 546·3 | 548·1 | 550·0 | 551·8 | 553·7 | 29 |
| 30 | 555·5 | 557·4 | 559·2 | 561·1 | 562·9 | 564·8 | 566·6 | 568·5 | 570·3 | 572·2 | 30 |
| 31 | 574·0 | 575·9 | 577·7 | 579·6 | 581·5 | 583·3 | 585·2 | 587·0 | 588·9 | 590·7 | 31 |
| 32 | 592·6 | 594·4 | 596·3 | 598·1 | 600·0 | 601·8 | 603·7 | 605·5 | 607·4 | 609·2 | 32 |
| 33 | 611·1 | 612·9 | 614·8 | 616·6 | 618·5 | 620·2 | 622·2 | 624·0 | 625·9 | 627·8 | 33 |
| 34 | 629·2 | 631·5 | 633·3 | 635·2 | 637·0 | 638·9 | 640·7 | 642·6 | 644·4 | 646·3 | 34 |
| 35 | 648·1 | 650·0 | 651·8 | 653·7 | 655·5 | 657·4 | 659·2 | 661·1 | 662·9 | 664·8 | 35 |
| 36 | 666·6 | 668·5 | 670·3 | 672·2 | 674·0 | 675·9 | 677·8 | 679·6 | 681·5 | 683·3 | 36 |
| 37 | 685·2 | 687·0 | 688·9 | 690·7 | 692·6 | 694·4 | 696·3 | 698·1 | 700·0 | 701·8 | 37 |
| 38 | 703·7 | 705·5 | 707·4 | 709·3 | 711·1 | 712·9 | 714·8 | 716·6 | 718·5 | 720·3 | 38 |
| 39 | 722·2 | 724·0 | 725·9 | 727·8 | 729·6 | 731·5 | 733·3 | 735·2 | 737·0 | 738·9 | 39 |
| 40 | 740·7 | 742·6 | 744·4 | 746·3 | 748·1 | 750·0 | 751·8 | 753·7 | 755·5 | 757·4 | 40 |
| 41 | 759·2 | 761·1 | 762·9 | 764·8 | 766·6 | 768·5 | 770·3 | 772·2 | 774·0 | 775·9 | 41 |
| 42 | 777·8 | 779·6 | 781·5 | 783·3 | 785·2 | 787·0 | 788·9 | 790·7 | 792·6 | 794·4 | 42 |
| 43 | 796·3 | 798·1 | 800·0 | 801·8 | 803·7 | 805·5 | 807·4 | 809·2 | 811·1 | 812·9 | 43 |
| 44 | 814·8 | 816·6 | 818·5 | 820·3 | 822·2 | 824·0 | 825·9 | 827·8 | 829·6 | 831·5 | 44 |
| 45 | 833·3 | 835·2 | 837·0 | 838·9 | 840·7 | 842·6 | 844·4 | 846·3 | 848·1 | 850·0 | 45 |
| 46 | 851·8 | 853·7 | 855·5 | 857·4 | 859·2 | 861·1 | 862·9 | 864·8 | 866·6 | 868·5 | 46 |
| 47 | 870·3 | 872·2 | 874·0 | 875·9 | 877·8 | 879·7 | 881·5 | 883·3 | 885·2 | 887·0 | 47 |
| 48 | 888·9 | 890·7 | 892·6 | 894·4 | 896·3 | 898·1 | 900·0 | 901·8 | 903·9 | 905·5 | 48 |
| 49 | 907·4 | 909·2 | 911·1 | 912·9 | 914·8 | 916·6 | 918·5 | 920·3 | 922·2 | 924·0 | 49 |
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |

| Areas. | ·1 | ·2 | ·3 | ·4 | ·5 | ·6 | ·7 | ·8 | ·9 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Contents. | 0·2 | 0·3 | 0·5 | 0·7 | 0·9 | 1·1 | 1·3 | 1·5 | 1·6 | |

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 250 | 46296 | 46315 | 46333 | 46351 | 46370 | 46389 | 46407 | 46426 | 46444 | 46463 | 250 |
| 251 | 46481 | 46500 | 46519 | 46537 | 46555 | 46574 | 46593 | 46611 | 46629 | 46648 | 251 |
| 252 | 46667 | 46685 | 46703 | 46722 | 46740 | 46759 | 46778 | 46796 | 46815 | 46833 | 252 |
| 253 | 46851 | 46870 | 46889 | 46908 | 46926 | 46944 | 46963 | 46981 | 47000 | 47018 | 253 |
| 254 | 47037 | 47055 | 47074 | 47093 | 47111 | 47129 | 47147 | 47166 | 47185 | 47203 | 254 |
| 255 | 47222 | 47240 | 47259 | 47278 | 47296 | 47315 | 47333 | 47351 | 47370 | 47389 | 255 |
| 256 | 47407 | 47426 | 47444 | 47463 | 47481 | 47500 | 47518 | 47537 | 47555 | 47573 | 256 |
| 257 | 47592 | 47611 | 47630 | 47648 | 47666 | 47685 | 47703 | 47722 | 47740 | 47759 | 257 |
| 258 | 47778 | 47796 | 47815 | 47833 | 47851 | 47870 | 47889 | 47908 | 47926 | 47944 | 258 |
| 259 | 47963 | 47981 | 48000 | 48018 | 48037 | 48055 | 48074 | 48093 | 48111 | 48129 | 259 |
| 260 | 48148 | 48166 | 48185 | 48203 | 48222 | 48240 | 48259 | 48278 | 48296 | 48315 | 260 |
| 261 | 48333 | 48351 | 48370 | 48389 | 48407 | 48426 | 48444 | 48463 | 48481 | 48500 | 261 |
| 262 | 48518 | 48537 | 48555 | 48573 | 48593 | 48611 | 48629 | 48648 | 48666 | 48684 | 262 |
| 263 | 48703 | 48722 | 48740 | 48758 | 48777 | 48796 | 48815 | 48833 | 48851 | 48870 | 263 |
| 264 | 48889 | 48907 | 48926 | 48944 | 48963 | 48981 | 49000 | 49018 | 49037 | 49055 | 264 |
| 265 | 49073 | 49093 | 49111 | 49129 | 49148 | 49166 | 49185 | 49203 | 49222 | 49240 | 265 |
| 266 | 49258 | 49277 | 49296 | 49315 | 49333 | 49351 | 49370 | 49389 | 49407 | 49425 | 266 |
| 267 | 49444 | 49463 | 49481 | 49500 | 49518 | 49537 | 49555 | 49574 | 49593 | 49611 | 267 |
| 268 | 49630 | 49648 | 49666 | 49685 | 49703 | 49722 | 49740 | 49759 | 49778 | 49796 | 268 |
| 269 | 49815 | 49833 | 49851 | 49870 | 49889 | 49907 | 49926 | 49944 | 49963 | 49981 | 269 |
| 270 | 50000 | 50018 | 50037 | 50055 | 50074 | 50093 | 50111 | 50129 | 50148 | 50166 | 270 |
| 271 | 50185 | 50203 | 50222 | 50240 | 50259 | 50278 | 50296 | 50315 | 50333 | 50351 | 271 |
| 272 | 50370 | 50389 | 50407 | 50426 | 50444 | 50463 | 50481 | 50500 | 50518 | 50537 | 272 |
| 273 | 50555 | 50574 | 50593 | 50611 | 50629 | 50648 | 50666 | 50685 | 50703 | 50722 | 273 |
| 274 | 50740 | 50759 | 50778 | 50796 | 50815 | 50833 | 50851 | 50870 | 50889 | 50907 | 274 |
| 275 | 50926 | 50944 | 50963 | 50981 | 51000 | 51018 | 51037 | 51055 | 51074 | 51093 | 275 |
| 276 | 51111 | 51129 | 51148 | 51166 | 51185 | 51203 | 51222 | 51240 | 51259 | 51277 | 276 |
| 277 | 51296 | 51315 | 51333 | 51351 | 51370 | 51389 | 51408 | 51426 | 51444 | 51463 | 277 |
| 278 | 51481 | 51500 | 51518 | 51537 | 51555 | 51574 | 51593 | 51611 | 51630 | 51648 | 278 |
| 279 | 51666 | 51685 | 51703 | 51722 | 51740 | 51759 | 51778 | 51796 | 51815 | 51833 | 279 |
| 280 | 51851 | 51870 | 51889 | 51907 | 51926 | 51944 | 51963 | 51981 | 52000 | 52018 | 280 |
| 281 | 52037 | 52055 | 52074 | 52093 | 52111 | 52129 | 52148 | 52166 | 52185 | 52204 | 281 |
| 282 | 52222 | 52240 | 52259 | 52278 | 52296 | 52315 | 52333 | 52351 | 52370 | 52389 | 282 |
| 283 | 52407 | 52426 | 52444 | 52463 | 52481 | 52500 | 52518 | 52537 | 52555 | 52573 | 283 |
| 284 | 52592 | 52611 | 52629 | 52648 | 52666 | 52685 | 52703 | 52722 | 52740 | 52759 | 284 |
| 285 | 52778 | 52796 | 52815 | 52833 | 52851 | 52870 | 52889 | 52907 | 52926 | 52944 | 285 |
| 286 | 52963 | 52981 | 53000 | 53018 | 53037 | 53055 | 53074 | 53093 | 53111 | 53129 | 286 |
| 287 | 53148 | 53166 | 53185 | 53203 | 53222 | 53240 | 53259 | 53278 | 53296 | 53315 | 287 |
| 288 | 53333 | 53351 | 53370 | 53389 | 53407 | 53425 | 53444 | 53463 | 53481 | 53500 | 288 |
| 289 | 53518 | 53537 | 53555 | 53574 | 53592 | 53611 | 53629 | 53648 | 53666 | 53685 | 289 |
| 290 | 53703 | 53722 | 53740 | 53759 | 53778 | 53796 | 53815 | 53833 | 53851 | 53870 | 290 |
| 291 | 53889 | 53907 | 53925 | 53944 | 53963 | 53981 | 54000 | 54018 | 54037 | 54055 | 291 |
| 292 | 54074 | 54092 | 54111 | 54129 | 54148 | 54166 | 54185 | 54203 | 54222 | 54240 | 292 |
| 293 | 54259 | 54278 | 54296 | 54315 | 54333 | 54351 | 54370 | 54389 | 54407 | 54425 | 293 |
| 294 | 54444 | 54463 | 54481 | 54500 | 54518 | 54537 | 54555 | 54574 | 54593 | 54611 | 294 |
| 295 | 54629 | 54648 | 54666 | 54685 | 54703 | 54722 | 54740 | 54759 | 54778 | 54796 | 295 |
| 296 | 54815 | 54833 | 54851 | 54870 | 54889 | 54907 | 54925 | 54944 | 54963 | 54981 | 296 |
| 297 | 55000 | 55018 | 55037 | 55055 | 55074 | 55093 | 55111 | 55129 | 55148 | 55166 | 297 |
| 298 | 55185 | 55203 | 55222 | 55240 | 55259 | 55278 | 55296 | 55315 | 55333 | 55351 | 298 |
| 299 | 55370 | 55389 | 55407 | 55426 | 55444 | 55463 | 55481 | 55500 | 55518 | 55537 | 299 |
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |

FIG. 9 AND FIG. 10. TABLE OF QUANTITIES FROM SUM OF END AREA S FOR PRISMOIDS OF 100 FEET EACH.

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sponding yardage can be computed or more readily taken from a table of sums of end areas.

A correction for yardage should be made both in fill and excavation. In excavation where material is common there is always a variable loss from several different sources. Where the clearing is heavy, a noticeable loss results from blasting and removing stumps. This percentage of loss is a variable quantity according to the number and size of stumps to be removed and depth of the cut. As the cut increases it is natural that percentage decreases. Another cause results from waste of surface materials that are not usable in fills. This percentage is also subject to the depth of cut. In cuts of 5 ft. or over, loss in excavation from either of the above causes is negligible. The contractor should be paid for the yardage removed, but it becomes necessary to allow for loss to obtain a reliable balanced grade line and determine the overhaul.

The correction in the fill results from shrinkage of material, settlement of ground upon which fill is made, and removal of such débris and surface vegetation necessary to good construction. All three of the above causes shall be referred to as shrinkage when spoken of hereafter. This shrinkage is a variable quantity and must be taken into consideration for any depth of fill. In slight fills the shrinkage is sometimes as high as 30%, and in the largest fills should run under 15% only in exceptional cases. The shrinkage alone might be only 5 to 10%, but settlement and removal of surface material can easily make up the difference (see Fig. 11 and Fig. 12).

In rock fill the material may expand 5 to 50%, according to classification. It is a very difficult thing to tell the probable expansion of classified materials in advance of work performed. An endeavor should be made to determine this as accurately as possible to give an intelligent estimate of work to be done. A good guess is better than passing by this item of loss and shrinkage.

After making corrections for loss and shrinkage, quantities should be added for each fill and cut. Should these quantities not balance, then the grade line should be shifted until a result is obtained where cut will

Correction For Curvature
Yardage – Percentage.

| Deg. of Cur. | Distance Ctr. of Grav. from Center. 2 | 4 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.3 | 0.7 | 1.0 | 1.2 | 1.4 | 1.6 | 1.7 | 1.9 | 2.1 | 2.3 | 2.4 |
| 16 | 0.6 | 1.1 | 1.7 | 2.0 | 2.2 | 2.5 | 2.8 | 3.1 | 3.3 | 3.6 | 3.9 |
| 20 | 0.7 | 1.4 | 2.1 | 2.4 | 2.8 | 3.1 | 3.5 | 3.8 | 4.2 | 4.5 | 4.9 |
| 24 | 0.8 | 1.7 | 2.5 | 2.9 | 3.3 | 3.8 | 4.2 | 4.6 | 5.0 | 5.4 | 5.9 |
| 26 | 0.9 | 1.8 | 2.7 | 3.2 | 3.6 | 4.1 | 4.5 | 5.0 | 5.4 | 5.9 | 6.3 |
| 28 | 1.0 | 1.9 | 2.9 | 3.4 | 3.9 | 4.4 | 4.9 | 5.4 | 5.9 | 6.4 | 6.8 |
| 30 | 1.0 | 2.1 | 3.1 | 3.7 | 4.2 | 4.7 | 5.2 | 5.8 | 6.3 | 6.8 | 7.3 |
| 32 | 1.1 | 2.2 | 3.3 | 3.9 | 4.4 | 5.0 | 5.6 | 6.1 | 6.7 | 7.3 | 7.8 |
| 34 | 1.1 | 2.4 | 3.6 | 4.2 | 4.7 | 5.3 | 5.9 | 6.5 | 7.1 | 7.7 | 8.3 |
| 36 | 1.3 | 2.5 | 3.7 | 4.4 | 5.0 | 5.7 | 6.3 | 6.9 | 7.5 | 8.2 | 8.8 |
| 38 | 1.3 | 2.6 | 4.0 | 4.6 | 5.3 | 6.0 | 6.6 | 7.3 | 8.0 | 8.6 | 9.3 |
| 40 | 1.4 | 2.8 | 4.2 | 4.9 | 5.6 | 6.3 | 7.0 | 7.7 | 8.4 | 9.1 | 9.8 |
| 42 | 1.5 | 2.9 | 4.4 | 5.1 | 5.9 | 6.6 | 7.3 | 8.1 | 8.8 | 9.5 | 10.3 |
| 44 | 1.5 | 3.1 | 4.6 | 5.4 | 6.1 | 6.9 | 7.7 | 8.4 | 9.2 | 10.0 | 10.8 |
| 46 | 1.6 | 3.2 | 4.8 | 5.6 | 6.4 | 7.2 | 8.0 | 8.8 | 9.6 | 10.4 | 11.2 |
| 48 | 1.7 | 3.4 | 5.0 | 5.9 | 6.7 | 7.5 | 8.4 | 9.2 | 10.1 | 10.9 | 11.7 |
| 50 | 1.7 | 3.5 | 5.2 | 6.1 | 7.0 | 7.9 | 8.7 | 9.6 | 10.5 | 11.3 | 12.2 |
| 52 | 1.8 | 3.6 | 5.4 | 6.4 | 7.3 | 8.2 | 9.1 | 10.0 | 10.9 | 11.8 | 12.7 |
| 54 | 1.9 | 3.8 | 5.7 | 6.6 | 7.5 | 8.5 | 9.4 | 10.4 | 11.3 | 12.3 | 13.2 |
| 56 | 2.0 | 3.9 | 5.9 | 6.8 | 7.8 | 8.8 | 9.8 | 10.8 | 11.7 | 12.7 | 13.7 |
| 58 | 2.0 | 4.0 | 6.1 | 7.1 | 8.1 | 9.1 | 10.1 | 11.1 | 12.1 | 13.2 | 14.2 |
| 60 | 2.1 | 4.2 | 6.3 | 7.3 | 8.4 | 9.4 | 10.5 | 11.5 | 12.6 | 13.6 | 14.7 |
| 62 | 2.2 | 4.3 | 6.5 | 7.6 | 8.7 | 9.7 | 10.8 | 11.9 | 13.0 | 14.1 | 15.1 |
| 64 | 2.2 | 4.5 | 6.7 | 7.8 | 8.9 | 10.0 | 11.2 | 12.3 | 13.4 | 14.5 | 15.6 |
| 66 | 2.3 | 4.6 | 6.9 | 8.1 | 9.2 | 10.4 | 11.5 | 12.7 | 13.8 | 15.0 | 16.1 |
| 68 | 2.4 | 4.7 | 7.1 | 8.3 | 9.5 | 10.7 | 11.9 | 13.1 | 14.2 | 15.4 | 16.6 |
| 70 | 2.4 | 4.9 | 7.3 | 8.6 | 9.8 | 11.0 | 12.2 | 13.4 | 14.7 | 15.9 | 17.1 |
| 72 | 2.5 | 5.0 | 7.5 | 8.8 | 10.1 | 11.3 | 12.6 | 13.8 | 15.1 | 16.3 | 17.6 |
| 74 | 2.6 | 5.2 | 7.7 | 9.0 | 10.3 | 11.6 | 13.0 | 14.2 | 15.5 | 16.8 | 18.1 |
| 76 | 2.7 | 5.3 | 8.0 | 9.3 | 10.6 | 11.9 | 13.3 | 14.6 | 15.9 | 17.2 | 18.6 |
| 78 | 2.7 | 5.4 | 8.1 | 9.5 | 10.9 | 12.2 | 13.6 | 15.0 | 16.3 | 17.7 | 19.1 |
| 80 | 2.8 | 5.6 | 8.4 | 9.8 | 11.2 | 12.6 | 14.0 | 15.4 | 16.8 | 18.1 | 19.5 |
| 82 | 2.9 | 5.7 | 8.6 | 10.0 | 11.4 | 12.9 | 14.3 | 15.7 | 17.2 | 18.6 | 20.0 |
| 84 | 2.9 | 5.9 | 8.8 | 10.3 | 11.7 | 13.2 | 14.7 | 16.1 | 17.6 | 19.0 | 20.5 |
| 86 | 3.0 | 6.0 | 9.0 | 10.5 | 12.0 | 13.5 | 15.0 | 16.5 | 18.0 | 19.5 | 21.0 |
| 88 | 3.1 | 6.1 | 9.2 | 10.8 | 12.3 | 13.8 | 15.4 | 16.9 | 18.4 | 20.0 | 21.5 |
| 90 | 3.1 | 6.3 | 9.4 | 11.0 | 12.6 | 14.1 | 15.7 | 17.3 | 18.9 | 20.4 | 22.0 |
| 92 | 3.2 | 6.4 | 9.6 | 11.2 | 12.8 | 14.4 | 16.1 | 17.7 | 19.3 | 20.9 | 22.5 |
| 94 | 3.3 | 6.6 | 9.8 | 11.5 | 13.1 | 14.8 | 16.4 | 18.0 | 19.7 | 21.3 | 23.0 |
| 96 | 3.4 | 6.7 | 10.0 | 11.7 | 13.4 | 15.1 | 16.8 | 18.4 | 20.1 | 21.8 | 23.5 |
| 98 | 3.4 | 6.8 | 10.3 | 12.0 | 13.7 | 15.4 | 17.1 | 18.8 | 20.5 | 22.2 | 23.9 |
| 100 | 3.5 | 7.0 | 10.5 | 12.2 | 14.0 | 15.7 | 17.5 | 19.2 | 20.9 | 22.7 | 24.4 |
| 120 | 4.2 | 8.4 | 12.6 | 14.7 | 16.8 | 18.8 | 20.9 | 23.0 | 25.1 | 27.2 | 29.3 |
| 140 | 4.9 | 9.8 | 14.7 | 17.1 | 19.5 | 22.0 | 24.4 | 26.9 | 29.3 | 31.8 | 34.2 |
| 160 | 5.6 | 11.2 | 16.8 | 19.5 | 22.4 | 25.1 | 27.9 | 30.7 | 33.5 | 36.3 | 39.1 |
| 180 | 6.3 | 12.6 | 18.8 | 22.0 | 25.1 | 28.3 | 31.4 | 34.6 | 37.7 | 40.8 | 44.0 |

FIG. 14.

Correction For Curvature
Yardage – Percentage.

| Deg. of Cur. | Distance Ctr. of Grav. from Center. 15 | 16 | 17 | 18 | 19 | 20 | 22 | 24 | 26 | 28 | 30 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 2.6 | 2.8 | 3.0 | 3.1 | 3.3 | 3.5 | 3.8 | 4.2 | 4.5 | 4.9 | 5.2 |
| 16 | 4.2 | 4.5 | 4.7 | 5.1 | 5.3 | 5.6 | 6.1 | 6.7 | 7.2 | 7.8 | 8.2 |
| 20 | 5.2 | 5.6 | 5.9 | 6.3 | 6.6 | 7.0 | 7.7 | 8.4 | 9.1 | 9.8 | 10.5 |
| 24 | 6.3 | 6.7 | 7.1 | 7.5 | 8.0 | 8.4 | 8.2 | 10.0 | 10.8 | 11.7 | 12.6 |
| 26 | 6.8 | 7.3 | 7.7 | 8.2 | 8.6 | 9.1 | 10.0 | 10.9 | 11.8 | 12.7 | 13.6 |
| 28 | 7.3 | 7.8 | 8.3 | 8.8 | 9.3 | 9.8 | 10.8 | 11.7 | 12.7 | 13.7 | 14.7 |
| 30 | 7.9 | 8.4 | 8.9 | 9.4 | 9.9 | 10.5 | 11.5 | 12.6 | 13.6 | 14.7 | 15.7 |
| 32 | 8.4 | 8.9 | 9.5 | 10.0 | 10.6 | 11.1 | 12.2 | 13.3 | 14.4 | 15.6 | 16.7 |
| 34 | 8.9 | 9.5 | 10.0 | 10.7 | 11.3 | 11.9 | 13.1 | 14.2 | 15.4 | 16.6 | 17.8 |
| 36 | 9.4 | 10.1 | 10.7 | 11.3 | 11.9 | 12.6 | 13.9 | 15.1 | 16.4 | 17.6 | 18.9 |
| 38 | 9.9 | 10.6 | 11.3 | 11.9 | 12.6 | 13.3 | 14.6 | 15.9 | 17.2 | 18.6 | 19.9 |
| 40 | 10.5 | 11.2 | 11.9 | 12.6 | 13.3 | 14.0 | 15.4 | 16.8 | 18.1 | 19.5 | 20.9 |
| 42 | 11.0 | 11.7 | 12.4 | 13.2 | 13.9 | 14.7 | 16.1 | 17.6 | 19.1 | 20.5 | 22.0 |
| 44 | 11.5 | 12.3 | 13.0 | 13.8 | 14.6 | 15.4 | 16.9 | 18.4 | 20.0 | 21.5 | 23.0 |
| 46 | 12.0 | 12.8 | 13.6 | 14.4 | 15.2 | 16.1 | 17.7 | 19.3 | 20.9 | 22.5 | 24.1 |
| 48 | 12.6 | 13.4 | 14.2 | 15.1 | 15.9 | 16.8 | 18.4 | 20.1 | 21.8 | 23.5 | 25.1 |
| 50 | 13.1 | 13.9 | 14.8 | 15.7 | 16.6 | 17.5 | 19.2 | 20.9 | 22.7 | 24.4 | 26.2 |
| 52 | 13.6 | 14.5 | 15.4 | 16.3 | 17.2 | 18.1 | 19.9 | 21.7 | 23.6 | 25.4 | 27.2 |
| 54 | 14.1 | 15.1 | 16.0 | 17.0 | 17.9 | 18.8 | 20.7 | 22.6 | 24.5 | 26.4 | 28.3 |
| 56 | 14.7 | 15.6 | 16.6 | 17.6 | 18.6 | 19.5 | 21.5 | 23.5 | 25.4 | 27.4 | 29.3 |
| 58 | 15.2 | 16.2 | 17.2 | 18.2 | 19.2 | 20.2 | 22.3 | 24.3 | 26.3 | 28.3 | 30.4 |
| 60 | 15.7 | 16.8 | 17.8 | 18.9 | 19.9 | 20.9 | 23.0 | 25.1 | 27.2 | 29.3 | 31.4 |
| 62 | 16.2 | 17.3 | 18.4 | 19.5 | 20.6 | 21.6 | 23.8 | 26.0 | 28.1 | 30.3 | 32.5 |
| 64 | 16.7 | 17.9 | 19.0 | 20.1 | 21.2 | 22.3 | 24.6 | 26.8 | 29.0 | 31.3 | 33.5 |
| 66 | 17.3 | 18.4 | 19.6 | 20.7 | 21.9 | 23.0 | 25.3 | 27.6 | 30.0 | 32.2 | 34.4 |
| 68 | 17.8 | 19.0 | 20.2 | 21.4 | 22.6 | 23.7 | 26.1 | 28.5 | 30.9 | 33.2 | 35.6 |
| 70 | 18.3 | 19.5 | 20.8 | 22.0 | 23.2 | 24.4 | 26.9 | 29.3 | 31.8 | 34.2 | 36.7 |
| 72 | 18.8 | 20.1 | 21.4 | 22.6 | 23.9 | 25.1 | 27.6 | 30.2 | 32.7 | 35.2 | 37.7 |
| 74 | 19.4 | 20.7 | 21.9 | 23.2 | 24.5 | 25.8 | 28.4 | 31.0 | 33.6 | 36.2 | 38.7 |
| 76 | 19.9 | 21.2 | 22.5 | 23.9 | 25.2 | 26.5 | 29.2 | 31.8 | 34.5 | 37.1 | 39.8 |
| 78 | 20.4 | 21.8 | 23.1 | 24.5 | 25.9 | 27.2 | 29.9 | 32.7 | 35.4 | 38.1 | 40.8 |
| 80 | 20.9 | 22.3 | 23.7 | 25.1 | 26.5 | 27.9 | 30.7 | 33.5 | 36.3 | 39.1 | 41.8 |
| 82 | 21.5 | 22.9 | 24.3 | 25.8 | 27.2 | 28.7 | 31.5 | 34.4 | 37.2 | 40.1 | 42.9 |
| 84 | 22.0 | 23.5 | 24.9 | 26.4 | 27.8 | 29.3 | 32.3 | 35.2 | 38.1 | 41.0 | 44.0 |
| 86 | 22.5 | 24.0 | 25.5 | 27.0 | 28.5 | 30.0 | 33.0 | 36.0 | 39.0 | 42.0 | 45.0 |
| 88 | 23.0 | 24.6 | 26.1 | 27.6 | 29.2 | 30.7 | 33.8 | 36.9 | 39.9 | 43.0 | 46.1 |
| 90 | 23.6 | 25.1 | 26.7 | 28.3 | 29.8 | 31.4 | 34.6 | 37.7 | 40.8 | 44.0 | 47.1 |
| 92 | 24.1 | 25.6 | 27.3 | 28.8 | 30.5 | 32.1 | 35.3 | 38.5 | 41.7 | 44.9 | 48.1 |
| 94 | 24.6 | 26.2 | 27.9 | 29.5 | 31.2 | 32.8 | 36.1 | 39.4 | 42.6 | 45.9 | 49.2 |
| 96 | 25.1 | 26.8 | 28.5 | 30.2 | 31.8 | 33.5 | 36.9 | 40.2 | 43.6 | 46.9 | 50.3 |
| 98 | 25.6 | 27.4 | 29.1 | 30.8 | 32.5 | 34.2 | 37.6 | 41.0 | 44.5 | 47.9 | 51.3 |
| 100 | 26.2 | 27.9 | 29.7 | 31.4 | 33.2 | 34.9 | 38.4 | 41.9 | 45.4 | 48.9 | 52.4 |
| 120 | 31.4 | 33.5 | 35.6 | 37.7 | 39.8 | 41.9 | 46.1 | 50.3 | 54.5 | 58.6 | 62.8 |
| 140 | 36.6 | 39.1 | 41.5 | 44.0 | 46.4 | 48.9 | 53.8 | 58.6 | 63.5 | 68.4 | 73.3 |
| 160 | 41.9 | 44.7 | 47.5 | 50.3 | 53.1 | 55.9 | 61.5 | 67.0 | 72.5 | 78.1 | |
| 180 | 47.1 | 50.2 | 53.4 | 56.5 | 59.7 | 62.3 | 68.5 | 74.8 | 81.0 | | |

FIG. 15.

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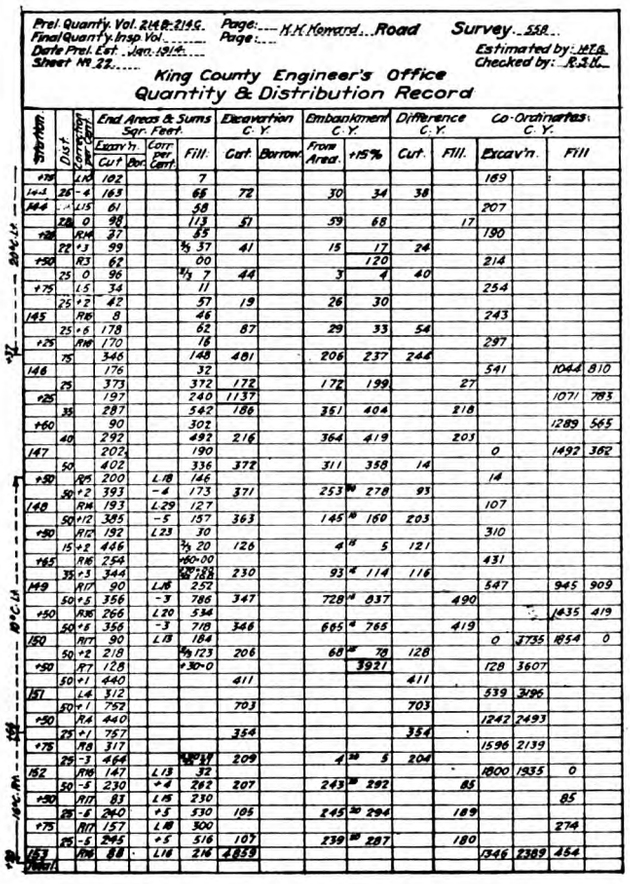
make the fills, or as near as practicable. It is advisable to put these quantities on the profile to determine any revisions in the grade. It is probable that only a portion of grade will need any alteration to balance quantities.

Being fully satisfied that a balance grade is obtained with a small percentage in favor of cuts, the next step is to make corrections for curvature in side-hill work. This is obtained by finding centre of gravity of the section and correcting the coördinate distance between stations of mean points of gravity. Everyone who is familiar with the method of finding the exact centre of gravity probably knows what tedious work



Prel. Quantity Vol. 214 & 214 G. Page: H.K. Kennard Road Survey. SSR.
Final Quantity Insp. Vol. Page:
Date Prel. Est. Jan. 1914 Estimated by: H.T.B.
Sheet No. 22 Checked by: R.S.C.

King County Engineer's Office
Quantity & Distribution Record

| Station | Dist. | Correction per cent | End Areas & Sums Sqr. Feet. Excav'n. Cut | Dor. | Corr. per Cent. | Fill. | Excavation C.Y. Cart. | Borrow | Embankment C.Y. From Area. | +15% | Difference C.Y. Cut. | Fill. | Co-Ordinates C.Y. Excav'n. | Fill |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| +75 | | L10 | 102 | | | 7 | | | | | | | 169 | |
| 1+45 | 25 | -4 | 165 | | | 66 | 72 | | 30 | 34 | 38 | | | |
| 144 | | L15 | 61 | | | 58 | | | | | | | 207 | |
| | 25 | 0 | 98 | | | 113 | 51 | | 59 | 68 | | 17 | | |
| +25 | | R14 | 87 | | | 85 | | | | | | | 190 | |
| | 22 | +3 | 99 | | | 1/3 37 | 41 | | 15 | 17 | 24 | | | |
| +50 | | R3 | 62 | | | 00 | | | | 120 | | | 214 | |
| | 25 | 0 | 96 | | | 1/3 7 | 44 | | 3 | 4 | 40 | | | |
| +75 | | L5 | 34 | | | 11 | | | | | | | 254 | |
| | 25 | +2 | 42 | | | 57 | 19 | | 26 | 30 | | | | |
| 145 | | R6 | 8 | | | 46 | | | | | | | 243 | |
| | 25 | +6 | 178 | | | 62 | 87 | | 29 | 33 | 54 | | | |
| +25 | | R10 | 170 | | | 18 | | | | | | | 297 | |
| | 75 | | 346 | | | 148 | 481 | | 206 | 237 | 246 | | | |
| 146 | | | 176 | | | 32 | | | | | | | 541 | 1044 | 810 |
| | 25 | | 373 | | | 372 | 172 | | 172 | 199 | | 27 | | |
| +25 | | | 197 | | | 240 | 1137 | | | | | | | 1071 | 783 |
| | 35 | | 287 | | | 542 | 186 | | 351 | 404 | | 218 | | |
| +60 | | | 90 | | | 302 | | | | | | | | 1289 | 565 |
| | 40 | | 292 | | | 492 | 216 | | 364 | 419 | | 203 | | |
| 147 | | | 202 | | | 190 | | | | | | | 0 | 1492 | 362 |
| | 50 | | 402 | | | 336 | 372 | | 311 | 358 | 14 | | | |
| +50 | | R5 | 200 | | L18 | 146 | | | | | | | 14 | |
| | 50 | +2 | 393 | | -4 | 173 | 371 | | 253 W | 278 | 93 | | | |
| 148 | | R14 | 193 | | L29 | 127 | | | | | | | 107 | |
| | 50 | +12 | 385 | | -5 | 157 | 363 | | 145 W | 160 | 203 | | | |
| +50 | | R12 | 192 | | L23 | 30 | | | | | | | 310 | |
| | 15 | +2 | 446 | | | 1/3 20 | 126 | | 4 W | 5 | 121 | | | |
| +65 | | R6 | 254 | | | +60-00 | | | | | | | 431 | |
| | 35 | +3 | 344 | | | 60+188 2 258 | 230 | | 93 W | 114 | 116 | | | |
| 149 | | R17 | 90 | | L16 | 252 | | | | | | | 547 | 945 | 909 |
| | 50 | +5 | 356 | | -3 | 786 | 347 | | 728 W | 937 | | 490 | | |
| +50 | | R16 | 266 | | L20 | 534 | | | | | | | | 1435 | 419 |
| | 50 | +8 | 356 | | -3 | 718 | 346 | | 665 W | 765 | | 419 | | |
| 150 | | R17 | 90 | | L18 | 184 | | | | | | | 0 | 3735 | 1854 | 0 |
| | 50 | +2 | 218 | | | 1/3 123 | 206 | | 68 W | 78 | 128 | | | |
| +50 | | R7 | 128 | | | +30-0 | | | | 3921 | | | 128 | 3607 | | |
| | 50 | +1 | 440 | | | | 411 | | | | 411 | | | |
| 151 | | L4 | 312 | | | | | | | | | | 539 | 3496 | | |
| | 50 | +1 | 752 | | | | 703 | | | | 703 | | | |
| +50 | | R4 | 440 | | | | | | | | | | 1242 | 2493 | | |
| | 25 | +1 | 757 | | | | 354 | | | | 354 | | | |
| +75 | | R8 | 317 | | | | | | | | | | 1596 | 2139 | | |
| | 25 | -3 | 464 | | | 1/3 47 | 209 | | 4 W | 5 | 204 | | | |
| 152 | | R14 | 147 | | L13 | 32 | | | | | | | 1800 | 1935 | 0 | |
| | 50 | -5 | 230 | | +4 | 262 | 207 | | 243 W | 282 | | 85 | | | |
| +50 | | R11 | 83 | | L15 | 230 | | | | | | | | 85 | |
| | 25 | -5 | 240 | | +5 | 530 | 105 | | 245 W | 294 | | 189 | | | |
| +75 | | R17 | 157 | | L18 | 300 | | | | | | | | 274 | |
| | 25 | -5 | 245 | | +5 | 516 | 107 | | 239 W | 287 | | 180 | | | |
| 153 | | R16 | 88 | | L16 | 216 | 4859 | | | | | | 1346 | 2389 | 454 | |
| Total | | | | | | | | | | | | | | | | |

FIG. 16. QUANTITY AND DISTRIBUTION RECORD.

it is to find this point in sections of two or more breaks. It would require a great deal of time and patience to use any method that requires such accuracy, and would not be consistent with this class of earth-work competition. Under these conditions, a good guess is much better than a poor calculation. The nearest 2 ft. would seem close enough, but one familiar with this work can determine this point 80 to 90% of the time to the nearest foot in sections that would be involved in good construction. (See Fig. 8 for centre line of gravity.)

On page 155 is a table of correction for curvature after the centre of gravity is found for curves from 10° to 180° and the mean distance out from 2 to 30 feet.

It will be seen from this table that correction for curvature in highway estimates is a very important item. For example, for a 40° curve, which is quite common, the mean distance of C is only 14 ft. out, the correction 9.8% and 30 ft. out, 20.9%. Correction thus obtained should be deducted or added, as the case may be, to the quantities previously noted and the percentage of correction given.

After making this correction, if the quantities are still within a reasonable balance, the difference in favor of cut or fill should be found for each section taken, and coördinate in both directions starting with 00 in each end of cut or fill. These coördinates of quantities should then be plotted upon profile paper to the same scale as used on profile longitudinally, and such scale vertical that will be convenient to show coördinated quantities to the best advantage. As distinction may be made by plotting fills in dotted lines. The best scale for road work is to let the finest lines or 1-ft. lines equal 20 cu. yd., the 5-ft. lines equal 100 cu. yd., and 50-ft. lines equal 100 cubic yards.

This quantity and distribution sheet is common to cross-sections in Fig. 8. It is a very convenient form for recording all data for estimating. In the first column insert station and distance; in small column, 'correction per cent,' insert both distance of right or left for centre of gravity and per cent of correction as derived from table in former illustration. Same column precedes area of fill, and should be treated in same manner as that of cut. The column for difference is intended to note the remaining yardage after a fill is made between same stations or difference of yardage in favor of either cut or fill. These differences are then added and sum taken for each station and noted in columns for coördinates of cuts and fills.

Fig. 17 shows the coördinates as determined in Fig. 16 and plotted on profile paper. Final profile is made between same stations. From these illustrations it can be seen by careful study how the overhaul is determined from the diagram, and the distribution of quantities can be derived by the same method. The distribution of quantities is shown in brackets below grade line of profile. In these same brackets is shown the overhaul for a given fill or fills.

It will be noted that nearly all excavation is hauled down hill on the steepest grade. Fig. 17 illustrates the method of platting the coördinates when a fill will exceed a cut for a short distance and it is desired to haul past this point, or cut will exceed a fill for a short distance.

This analytical drawing is generally termed overhaul diagram, but it serves two purposes in that it determines the number of cubic yards hauled per 100 ft. past the free haul, and the exact movement of all excess yardage. It will be seen in the illustrations that there are numerous flat places in coördinate lines. This is caused by the yardage of a cut exceeding that of the fill for a short distance, or *vice versa*, making it necessary to haul by these places to complete fill from the shortest haul. The overhaul is determined

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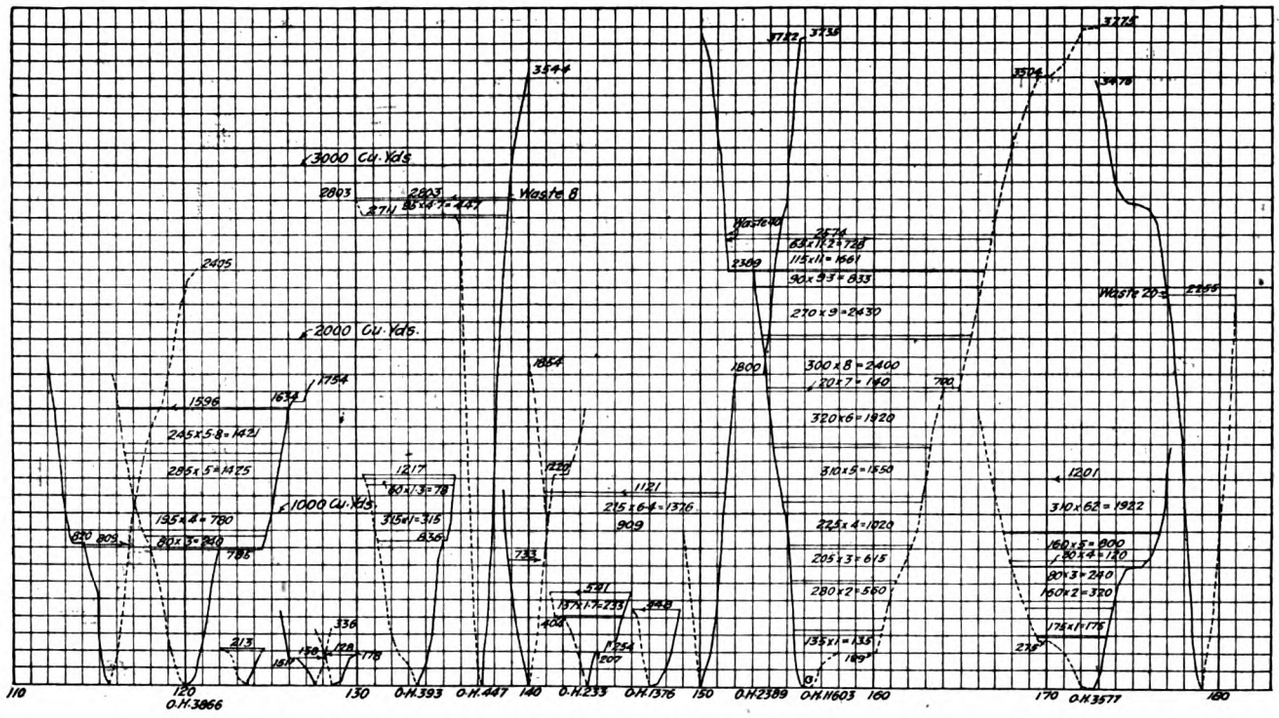


FIG. 17. COÖRDINATES AS DETERMINED IN FIG. 16 AND PLOTTED ON PROFILE PAPER.

by scaling equal 100-ft. lengths over and above free haul distance. This is obtained by using a scale equal to that used for diagram and drawing in a horizontal line at a point where an equal 100 ft. may come, repeating this for each 100 ft. until the required portion of fill or cut is reached or that portion remains from a haul taken in the opposite direction. (On grades that may exceed 2½%, care should be taken to move

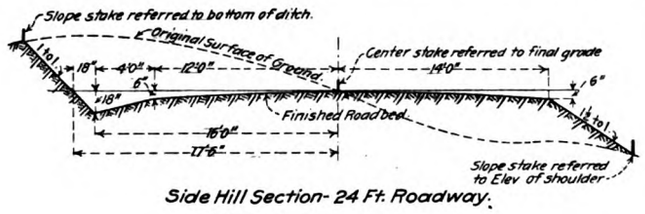
Slope stake referred to bottom of ditch.
Original Surface of Ground.
Center stake referred to final grade
Finished Roadbed
Slope stake referred to Elev of shoulder
Side Hill Section- 24 Ft. Roadway.

FIG. 18.

all material possible down hill, to facilitate the contractor in the execution of his work. It would be impossible to have all material move down hill. On level grades it is best to try and have material moved in both directions.) Upon these horizontal lines should be given the difference in quantities and the distance hauled past the free haul. The product of these items will give overhaul for each station, and the sum of these products will give the overhaul required to make a certain fill or fills from given cut or cuts. A line, drawn vertically through the point of intersection of horizontal line with the coördinate line in one direction, will give the remaining yardage of cut or fill on the coördinate line returning in the opposite direction.

From these coördinate lines readily can be seen the great convenience of showing movement of all material, whether overhaul or free haul, by simply using the horizontal lines drawn at such elevation of quantity that may be required and producing vertical lines through the point of intersection with the coördinate lines. These extremities of hauls can easily be reproduced upon the profile from the overhaul diagram, and the total yardage moved shown in brackets extending from the cuts into the fills together with waste or borrow that may be necessary to show the distribution.

No doubt the question will be asked by many who may read this discussion, why should there be such great care in estimating quantities before letting the contract? The answer is this: first, that the permanent highway law of the state of Washington requires that all contracts shall be let on lump sum basis; second, nearly all county work is let on lump sum basis. Under these conditions, it is only fair that the contractor should have the very best of information available to give an intelligent bid upon the work; and,

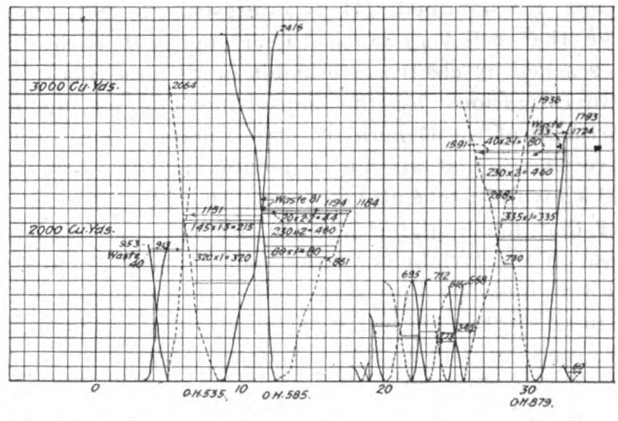


FIG. 19. COÖRDINATES OF QUANTITIES ARE GIVEN IN FIG. 16.

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being public work, the public should have a reliable estimate of cost before entering into any contract. Even when unit price basis is used in letting contract, a reliable estimate is only proper for the public's information, if for no other. The difference between the cost of a reliable estimate and a guess is small compared to the cost of the work to be done.

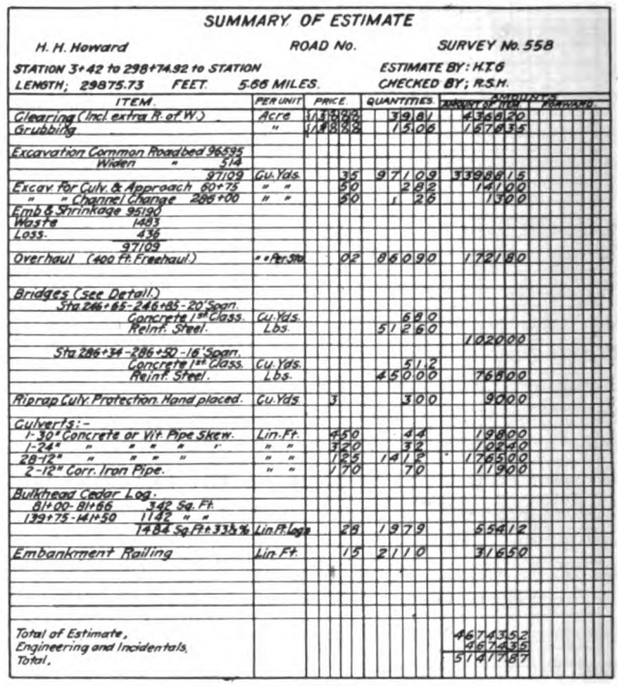
Following is the total work done under the supervision of King County Engineering Department for new construction in 1913:

TOTAL OF 1913 CONTRACTS

| | |
|---|---|
| Estimate of cost, including probable extras | $428,749.75 |
| Lump sum bid | 390,526.76 |
| Lump sum bid and probable extras | 396,076.04 |
| Extras allowed and force account allowed | 12,544.15 |
| Total amount of contract | 403,070.91 |
| Cost of engineers | 10,571.33 |

From this it can be seen that the engineer's estimates exceed actual cost of $25,678.84, or by about 6.3%. There was a probable loss to the contractor for the same year of $20,000, mostly on paved roads.

This office was criticized by a certain board of efficiency for the large amount of extras allowed. I am sure this board has a very poor understanding of the method of letting the contracts or they would not make such a statement. In the above statement you will note under lump sum bid, $390,526.76, and under lump sum bid and probable extras, $396,076.04, a difference of $5549.28 as probable extras. A contractor in submitting a bid agrees to do certain work such as culverts, bulkheads, and drains, for a unit price consideration. The letting of contract is subject to these unit prices for probable extras in the sum of total of bid. An effort is made to obtain this feature of the work as close as possible, but anyone familiar with earth work knows of the futility of securing data on probabilities. The total amount allowed for extras for 1913 contracts was $12,544.15, or $6994.87 over the amount allowed



SUMMARY OF ESTIMATE

H. H. Howard — ROAD No. — SURVEY No. 558

STATION 3+42 to 298+74.92 to STATION — ESTIMATE BY: H.I.G

LENGTH; 29875.73 FEET. 5.66 MILES. — CHECKED BY; R.S.H.

| ITEM | PER UNIT | PRICE | QUANTITIES | AMOUNT | REMARKS |
|---|---|---|---|---|---|
| Clearing (Incl. extra R. of W.) | Acre | $ 43.00 | 39.61 | 4356.20 | |
| Grubbing | " | 11.00 | 15.06 | 1657.66 | |
| Excavation Common Roadbed 96595 | | | | | |
| Widen " 514 | | | | | |
| 97109 | Cu. Yds. | .35 | 97109 | 33988.15 | |
| Excav. For Culv. & Approach 60+75 | " " | .50 | 2812 | 1406.00 | |
| " " Channel Change 286+00 | " " | .50 | 1220 | 610.00 | |
| Emb & Shrinkage 96590 | | | | | |
| Waste 1483 | | | | | |
| Loss. 436 | | | | | |
| 97109 | | | | | |
| Overhaul (400 Ft. Freehaul) | " Per Sta. | .02 | 86090 | 1721.80 | |
| Bridges (See Detail) | | | | | |
| Sta 286+85-246+85-20' Span. | | | | | |
| Concrete 1st Class. | Cu. Yds. | | 698 | | |
| Reinf. Steel. | Lbs. | | 51260 | | |
| | | | | 10200.00 | |
| Sta 286+34-286+50-16' Span. | | | | | |
| Concrete 1st Class. | Cu. Yds. | | 512 | | |
| Reinf. Steel. | Lbs. | | 45000 | 7680.00 | |
| Riprap Culv. Protection. Hand placed. | Cu. Yds. | 3. | 300 | 900.00 | |
| Culverts:- | | | | | |
| 1-30" Concrete or Vit. Pipe Skew. | Lin. Ft. | .450 | 44 | 1980.00 | |
| 1-24" " " " " | " " | .320 | 32 | 1024.40 | |
| 28-12" " " " " | " " | .125 | 1412 | 1765.00 | |
| 2-12" Corr. Iron Pipe. | " " | 1.70 | 70 | 119.00 | |
| Bulkhead Cedar Log: | | | | | |
| 81+00-81+66 142 Sq. Ft. | | | | | |
| 139+75-141+50 1142 " " | | | | | |
| 1484 Sq. Ft. @ 33.5% | Lin. Ft. Logs | .28 | 1979 | 554.12 | |
| Embankment Railing | Lin. Ft. | .15 | 2110 | 316.50 | |
| Total of Estimate, | | | | 46743.52 | |
| Engineering and Incidentals, | | | | 5067.35 | |
| Total, | | | | 51811.87 | |

FIG. 20. TYPICAL FORM FOR TABULATING SUMMARY OF ESTIMATE.

us figuring in the bids for letting of contract, or about 1.73% of cost of contracts. There are individual cases much higher than this, but it is only fair that the total work for 1913 should be considered for such comparison.

The question of a comparison between railway and highway estimating may be raised, but this can be explained by the fact that most of railroad work is not limited to cost for good construction, and the primary object is to construct a line on a given maximum curve and grade, while highway work is to obtain the best line for the least possible cost with a greater latitude permissible as to alignment and grade.

## ENERGY DENSITY

Usually, when considering high electric energy concentration, we think of the electric arc furnace, where thermal energy densities (temperatures) about twice as high as can be reached by combustion or any other means are obtained. It is interesting to note, however, that still very much higher energy densities can be reached by electrostatic fields in vacuum tubes.

Investigations by the consulting engineering department of the General Electric Company and others have shown that air has a definte dielectric strength (30 kilovolts per centimetre), at atmospheric pressure, but that much higher voltage gradients are reached close to the terminals of the spark gap, especially if the terminals are brought together to a distance within the dielectric energy distance (the space around the terminals in which the dielectric strength must be exceeded before rupture can occur). The dielectric strength decreases with the air pressure down to a minimum; but with still lower pressure, it increases again, since the energy distance, which increases with decreasing air pressure, becomes larger than the distance between the terminals. At a very high vacua the dielectric strength thus becomes very high, approaching values apparently of the magnitude of a million volts per centimetre. If then we calculate the energy stored in a cubic centimetre of space at a voltage gradient of a million volts per centimetre and the weight of the matter still existing in one cubic centimetre space at the highest vacua which have been reached, we find values per gram of matter of many millions of joules or calories, that is, energy densities thousands of times higher than those of the highest explosives. These energy densities are possibly the highest which can be reached. They are of the magnitude of the internal energy of radio-active atoms, and the phenomena of high electrostatic fields in high vacua thus would be the most promising starting point for an experimental study of the transformation of chemical elements into each other.—C. P. STEINMETZ, in the *General Electric Review*.

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# Dragging Earth Roads

The road drag is the simplest and least expensive contrivance yet devised for maintaining earth roads, according to the experts of the U. S. Department of Agriculture, who are coöperating with state and county authorities in work for better roads.

Properly used, the drag gives the needed crown to the road, smooths out ruts and other irregularities, spreads out puddles of water, thereby accelerating the drying of the road, and makes the surface more or less impervious to water by smearing over the so-called pores in the earthy material. The cost of operation depends, of course, upon local conditions and the thoroughness with which the work is done. It is safe to say, however, that it is less expensive than any other efficient system of upkeep.

Farmers' Bulletin No. 597, of the Department of Agriculture, discusses under the title of 'The Road Drag and How It Is Used,' the best methods of maintaining earth roads in good condition by this simple device. In this bulletin, which has just been published, the Department points out that, of more than 2,000,000 miles of public roads in the United States, only about 200,000 miles have been given a hard surface. It is true, of course, that a large part of the remaining mileage consists of roads that are entirely unimproved, and that on roads of this class the drag is practically useless. There is a much larger mileage, however, that has been partly improved, and it is on roads of this character—roads that have been crowned or drained, but have not a hard surface—that the use of the drag is advocated.

In its simplest form, the road drag consists of an ordinary log split in half and the two halves connected like the uprights of a ladder by means of cross sticks or rungs set in. The log should be about 7 or 8 in. diameter and from 6 to 8 ft. in length. It is better to have it of well seasoned, hard, tough wood. The two semi-cylindrical halves of the log form the runners of the drag, and are usually spaced from 30 to 36 in. apart. The front runner is always placed with the split surface of the wood facing forward, but the rear runner sometimes has its rounded face in front. This is done in order to increase the smearing action of the drag as it passes over the surface of the road.

The two runners are not placed directly behind each other, but are 'offset,' as it is called, from 12 to 16 in. This is done because the drag is drawn over the road at an angle sufficient to make the runners free themselves of the material which they scrape. The amount of this angle or skew depends, of course, upon the condition of the road. By offsetting the runners, it is possible to make their ends follow approximately the same line on the road, which they would not do if they were set directly behind each other and the drag drawn at an angle with the road.

In order to provide standing room for the man, it is usual to nail two boards down upon the rungs parallel to the runners. Standing upon these, a skillful driver will bear his weight in such a way as to aid materially in the successful operation of the drag.

The drag is drawn by a chain, which should be about 8 ft. long. This can be fastened by eye-bolts to each end of the front runner, or one end of the chain can pass through a hole at the discharge end of the front runner, and the other end be looped over the rung at the cutting end of the runner. It is important that the hitching link should be so designed that its position can be changed readily. It is also desirable to provide a metal cutting edge for the front runner. This can be made from a strip of iron or steel, and old wagon tires have frequently proved satisfactory.

The cost of such a drag varies from $2 to perhaps $10 or $12. This practically insignificant outlay will secure an implement that will be of great service to the community for at least three or four years. The fact cannot be overlooked, however, that skill in the use of the drag is indispensable.

The angle that the runners make with the centre line of the road, the skew angle as it might be called, is an important factor. For example, if the dragging is done to increase the crown of the road, the drag should be sufficiently skewed to discharge all material as rapidly as it is collected on the runners. On the other hand, the conditions may be such that it is desirable to carry along this material in order to deposit it where there are depressions in the road's surface.

An intelligent operator will very soon learn many ways of controlling the action of the drag. The length of the hitching chain, the disposition of the operator's weight, the time when the dragging is done, all these exert a marked influence upon the results.

As to the time for dragging, a safe rule to follow is to drag the road when the material composing the surface contains sufficient moisture to compact readily but is not sufficiently wet for traffic to produce mud.

Since the weather plays so important a part in the matter, it is not usually possible to arrange continuous employment for teams on the road. It is therefore desirable, whenever possible, to have the dragging done by persons interested in the road, who will do it in the intervals between other occupations.

## FORGING CARBON STEELS

Carbon steels should not be forged at a lower heat than about 1020°F., brown-red heat, as this will produce forging strains. Tools made in such a way are liable to burst, or to become seriously flawed in the centre, or to crack in hardening, especially if not previously annealed.

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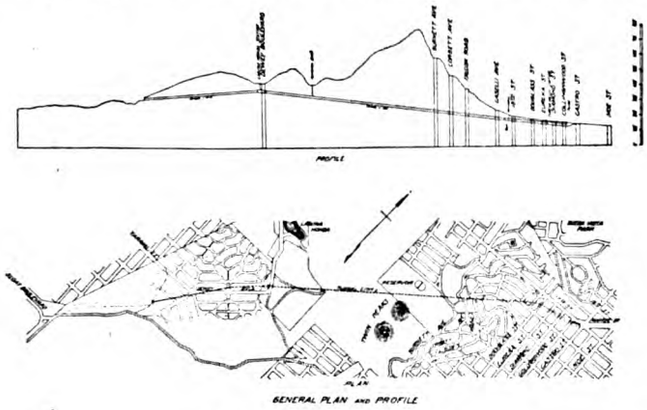
# The San Francisco Twin Peaks Tunnel Project

One of the several means recommended by Bion J. Arnold for improving the transportation facilities of the city of San Francisco is the construction of the Twin Peaks tunnel. The topography of San Francisco is such that a chain of hills, of which so-called Twin Peaks is a part, has thus far formed an effective barrier toward the settlement of a large and attractive acreage within the lines of the city and county. Boring the Twin Peaks tunnel, however, will bring this large area within approximately a 30-minute time zone of the business section of the city. Specifications for this large bore have been prepared by M. M. O'Shaughnessy, city engineer, at the direction of the San Francisco Board of Public Works, and from which the following data have been taken.



GENERAL PROFILE AND PLAN.

The contemplated work has been divided into 15 sections as follows:

2940 ft. of standard tunnel section through earth or other soft material and lined with reinforced concrete with an arch of concrete or brick, and including a complete drainage system, ducts, and conduits for electric cables, and the construction of the fill to subgrade over the invert.

4020 lin. ft. of tunnel section through soft rock and lined with reinforced concrete and including drainage system ducts and conduits for electric cable.

2500 lin. ft. of tunnel through hard rock, lined entirely with reinforced concrete and including drainage system ducts and conduits for electric cables.

30 lin. ft. of 29-ft. 6-in. tunnel made of reinforced concrete with an arch of concrete or brick and including the same accessories as above.

1360 lin. ft. of flat-top section made of reinforced concrete including drainage system, ducts, and conduits for electric cables and including also the replacement of sewers, curbs, sidewalks, and pavements that may have been disturbed in the construction of this section.

In addition to the above items there are a reinforced concrete taper connection, an easterly approach, and an easterly portal, retaining walls, station equipment, ventilating intake stations, and a tunnel drain.

In preparing the plans an exhaustive series of borings was made along the line of the tunnel in order to predetermine as nearly as possible the character of material and quantity of each class that would have to be excavated.

Inasmuch as reinforced concrete is the material decided upon by the engineers as being best adapted for use in supporting the bore and also for the more ornamental purposes of approaches, stations, kiosks, stairs, ballustrades, and other architectural features, a brief summary of the specifications in this respect will be of interest.

The portland cement to be used is required to have a specific gravity between 3.1 and 3.25 after having been thoroughly dried at a temperature of 212°F. Ninety-two per cent must pass a screen with 10,000 meshes to the square inch; 77% through a screen 40,000 meshes to the square inch. Neat cement briquettes are to develop a tensile strength after seven days of 500 lb.; after 28 days, 600 lb. Briquettes consisting of one part of cement and three parts sand are to have a tensile strength of 200 lb. after seven days and 300 lb. after 28 days. The sand used is to pass a 20-mesh screen and be rejected by a 30-mesh screen. Pats of neat cement about 3 in. diameter and ½ in. thick in the centre, tapering to a thin edge, after being kept in moist air at a normal temperature for 24 hours and placed in water and raised to a temperature of 212°F. in one hour and maintained at that temperature for five hours, and other parts kept one in open air and one in water at a temperature of about 65°F. for 28 days, shall show no sign of distortion, blotching, cracking, or disintegration. Ninety-four pounds of cement is considered as a cubic foot.

The sand required is to be subject to the following screen analysis: 10% retained on a 20-mesh screen and 70% retained on a 50-mesh screen. The broken rock for concrete work on foundations 2 ft. thick or over shall be in such sizes that two-thirds will pass a 2½-in. mesh screen and be rejected by 1¼-in. mesh screen. The other third is to pass a 1¼-in. screen and be rejected by a ⅜-in. screen. For other concrete work, the rock is to be of varying sizes, from that which will pass a 1-in. mesh down to that which will be rejected by a ¼-in. mesh, and not less than 25% shall pass a ½-in. mesh.

The steel for reinforcing shall include deformed bars only and shall conform to the manufacturers' specifications for medium steel for concrete reinforcement as adopted by the Association of American Steel Manufacturers in 1910. For reinforcing fabric, Clinton or its equal No. 8 by No. 8, 6 in. by 6 in., is to be used.

After the forms have been erected and before the

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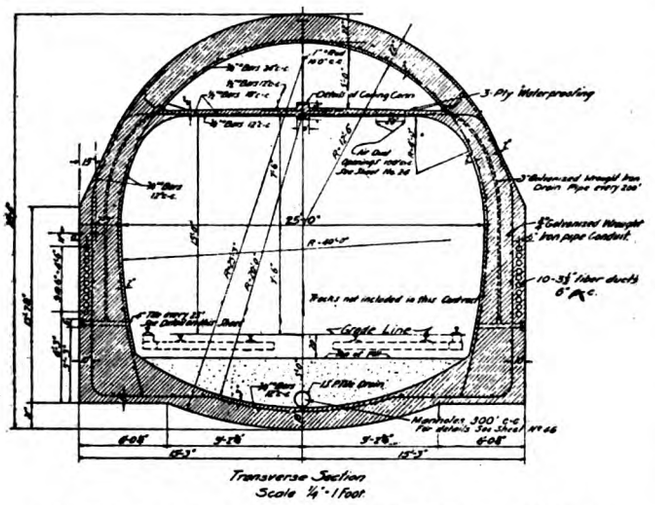
placing of concrete, the horizontal and vertical position of all forms are to be carefully verified and any inaccuracies corrected. The forms are to be thoroughly wet down with a hose and running water before placing concrete. Soaping or oiling the forms is forbidden. All concrete is to consist of mortar and broken rock, the mortar being composed of portland cement and sand in the proportion of one cubic foot of cement to 2¼ cu. ft. of sand. Batch machine mixing is prescribed, the mixer to be so arranged as to make four complete revolutions before any of the concrete is discharged for use. When fresh concrete is placed upon or against concrete which is set, the entire surface of the set concrete is to be thoroughly cleansed, washed with clean water, and then covered with a layer of liquid mortar composed of one part cement and one part sand, and the fresh concrete is to be

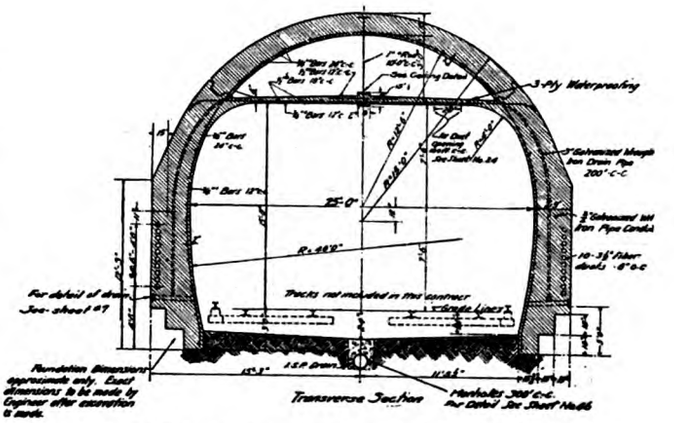



STANDARD TUNNEL SECTION FOR EARTH AND SOFT MATERIAL.

thoroughly worked against the old work. After concrete has been placed, all wheeling, working, and walking upon the concrete is to be prevented until at least 12 hours after it has been deposited. Forms for tunneling and curtain walls are not to be removed or disturbed for seven days from the date of the last pouring, while those for floor slabs and columns are not to be removed or disturbed for 14 days, and those for beams and girders 21 days.

It is interesting to note the prominent position that has been accorded to the cement-gun in the general specifications applying to the concrete work. Practically all of the finishing throughout is to be done by the cement-gun wherever possible, hand plastering being permitted only in cases where the cement-gun cannot be used. This is undoubtedly due to the degree of success which has been attended by the use of the cement-gun on other large pieces of municipal work. Waterproofing of the Twin Peaks reservoir, coating the Geary Street car-barns, the municipal incinerator stack, and the trolley poles for the municipal car line on Van Ness Avenue may be cited as instances.

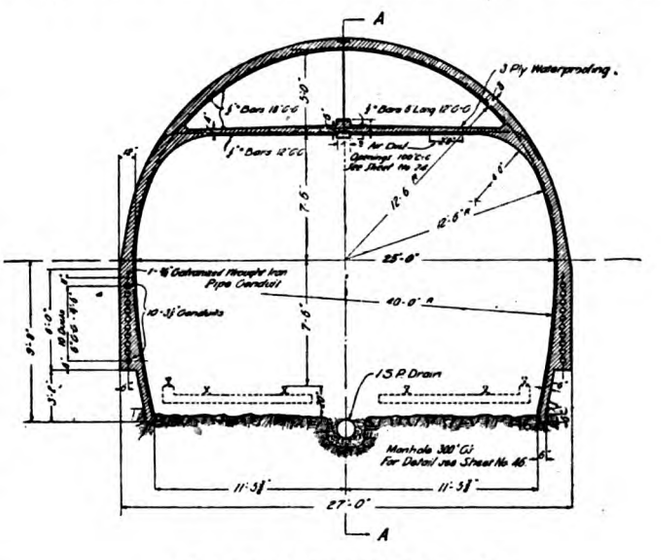
The concrete sidewalks for practically all of the tun-




STANDARD TUNNEL SECTION FOR SOFT ROCK.

nel project are to consist of a 3-in. concrete base with a ¾-in. cement finish, the base being in the proportion of one part of cement to 7½ parts of sand and broken rock, while the cement wearing surface is to consist of one part of cement and one part of fine topping gravel. Expansion joints are to be used, spaced not more than 75 ft. apart, and will extend across the sidewalk on lines at right angles to the curb. The joints are to be ½ in. wide for the full depth of the artificial stone, and, after the concrete has set, are to be filled with hot asphaltic cement, to which has been added enough powdered limestone to bring it to a suitable consistence.

The finish for the concrete floors, concrete stair risers, treads, and landings, and all concrete platforms, is to be ¾ in. thick and to consist of one part portland cement and one part of suitable topping gravel. The entire inside surface of the tunnel lining from portal to portal, the under side of all ceiling slabs in the tunnel, and all concrete surfaces to be exposed after completion in the approaches, portals, retaining walls, kiosks, stations, stair shafts, and elevator shafts, excepting the top surfaces of floor slabs, platforms.




STANDARD TUNNEL SECTION FOR HARD ROCK.

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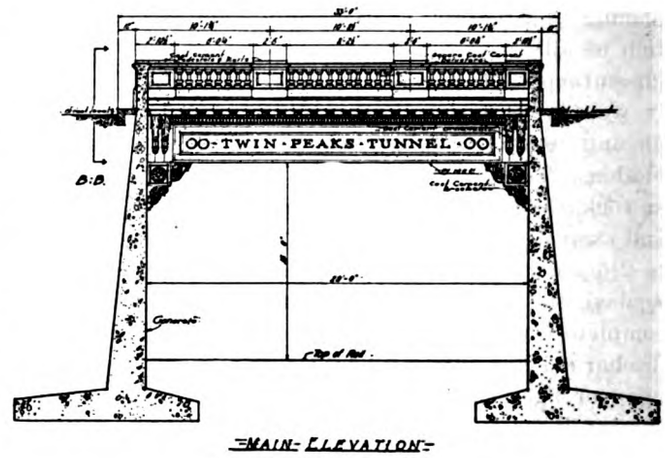
sidewalks, treads, risers, and landings of stairs, the top surfaces of all roof slabs, all surface buildings, and the bottom surfaces of all roof slabs in surface buildings having suspended ceilings, are to be finished with two coats of cement mortar, applied, so far as is practicable, by the cement-gun.

With the exception of Eureka Valley station, all exterior surfaces of all portions of the tunnel lining constructed in open cut, which are accessible, all exterior surfaces below the finished grade of vent shafts, of the stair shafts, and elevator shafts in the Laguna Honda station constructed in open cut which are accessible, and all rear surfaces below the finished grade of retaining walls, approaches, and portals which are accessible, are to be finished with one coat of cement mortar applied so far as practicable by means of the cement-gun. Either white Santa Cruz or white Atlas cement is to be used wherever required.

For roofing, a number of different combinations is to be used, among them being 3-ply felt and asphalt protected by a covering of tile for the Eureka Valley station, Trinidad asphalt and wool felt for the Laguna Honda station, and terra cotta roofing tile for this station and also for the kiosks in the Eureka Valley station. Vitrified pipe in diameters varying from 60 in. to 8 in. is to be used throughout for sewers or drains wherever required. Pipes and fittings for an auxiliary water-supply system for fire protection are also to be supplied and installed.

The work of paving includes the removal of all existing pavements, curbs, and sidewalks, together with whatever grading may be required. Concrete base is to be used in the proportion of 1 cu. ft. of cement to 3 cu. ft. of sand to 7 cu. ft. of rock. The base is to be 6 in. thick, upon which is to be laid a 2-in. binder course and 1½-in. asphaltic wearing surface. Subgrade is to be compacted with a steam roller weighing not less than five tons. After the concrete foundation has been allowed to set for seven days, an asphaltic concrete binder course is to be applied which, after compression, is to have a thickness not less than 2 inches. When this has been done, the asphaltic wearing surface, consisting of asphaltic cement, sand, and portland cement, is to be placed. The detailed

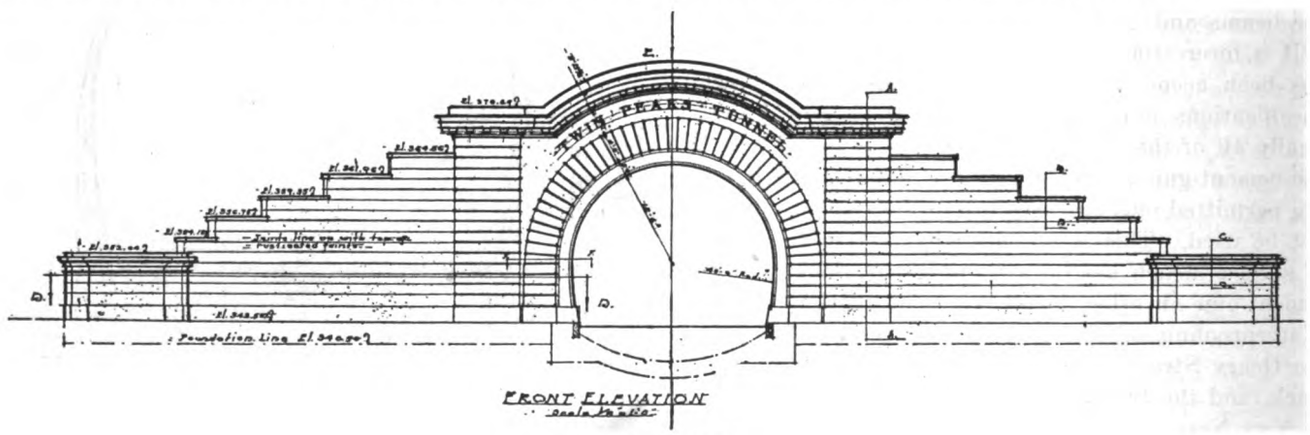



EASTERLY PORTAL.

composition of the material for the wearing surface is as follows: Bitumen soluble in chloroform, between 10½ and 14%; sand, portland cement, and other inorganic ingredients. Sand screen analysis follows:

| Passing screen Mesh No. | Mesh No. rejected by screen of | | | |
|---|---|---|---|---|
| 200 ..... | ... | between | 13 | and 18 |
| 80 ..... | 200 | " | 18 | " 28 |
| 50 ..... | 80 | " | 26 | " 36 |
| 30 ..... | 50 | " | 9 | " 19 |
| 20 ..... | 30 | " | 4 | " 8 |
| 10 ..... | 20 | " | ½ | " 2 |

The asphaltic cement and sand are to be heated separately to a temperature between 250 and 300°F. The portland cement is to be added and mixed with the hot sand before the asphaltic cement is added. The mixing of all ingredients is then to be continued until every particle of sand and portland cement is thoroughly coated with the asphaltic cement. The mixture is to be applied upon the street at a temperature not less than 250°F.; the stirring is to be done with hot shovels and rakes to such a depth that after compression with rollers weighing not less than 250 lb. per foot in width and a steam roller between 125 and 150 lb. per inch in width and a second steam roller weighing not less than 250 lb. per inch in width, its thickness shall not be less than 1½ inches.




WESTERLY PORTAL.

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# An Economic Phase of Irrigation

By ALBERT M. PAUL*

In the development of irrigation practice in the West, the necessity for correctly establishing the duty of water has become, and is becoming, still more imperative.

Recent years have seen many dirt ditches made into concrete or cement-lined ditches; open ditches have been replaced by cement, iron, or wooden pipes; in fact, a constant effort is being made to reduce seepage and evaporation losses to a minimum and thus conserve all the water which is available at the original source.

Other factors in the solution of the economic problem involved in the use of irrigation water are soil chemistry and bacteriology. They should always have a place in the conservation effort. The use of chemical and biological study has been brought about not so much in an effort to conserve the water-supply, but rather in an effort to give to irrigated crops the correct amount of water for which there is real use, and thus to guard against the handicap placed upon growing plants due to excess water in the soil.

Any soil investigation, be it that of fertilization, irrigation, or drainage, requires careful study of the 'Law of the Minimum.' The recognition of this law and the determination of the factor or factors which are present in the minimum has come to be a recognized necessity in work embraced in the field of agricultural engineering investigation. Based on such an investigation, recommendations are made for the proper economic methods to employ to bring these factors, as nearly as possible, into the optimum condition as developed by the law of the minimum.

Briefly tracing the development of the law of the minimum, we find that as far back as 1855 the distinguished agricultural chemist, Justus V. Liebig, determined "that if any nutritive substance in the soil be reduced to a minimum, the effect on the plant is much the same as though all the nutritive substances are likewise reduced." The proof of this law by Liebig is recognized as one of the greatest agricultural achievements that has taken place during the last century.

Liebig thus laid the cornerstone for a new and lasting agricultural development. The veil which obscured the functions of plant nutrition was lifted and the previous theories of von Hellmont, 17th century; Jethre Tull, 18th century; Albrecht Taer, 1752-1828, and many others were disproved. Liebig later saw that his incomplete premises were not final; he then propounded the law of the minimum as follows: "Every soil contains a maximum of one or more, and a minimum of one or more, of the elements of plant nutrition. This minimum may be lime, potassium, nitrogen, or phosphoric acid, or another ingredient; all the crops are in proportion. It regulates the heights and duration of the crop yields." Also, this discovery of the law of the minimum, which determined the value of mineral nutrition to plants, brought new developments into the new science which has since been called agricultural chemistry.

It was then thought that when all the mineral substances were supplied in abundance, the plant must develop to its maximum capacity. Much controversy arose over the fact that this was by no means always the case until Adolf Meyer and Edward Wollny showed that Liebig's law of the minimum also applied to the physical functions of the soil and every other factor that influenced plant growth.

Wollny showed clearly, in experimenting with rye and potatoes, that there was a stage of optimum water content in the soil for the development of that plant growth, and that a moisture content above or below the optimum water content in the soil was detrimental to the plant growth.

In California it is generally recognized that water helps very materially to increase the crops. Therefore, water as a factor can be said to be in the minimum. Its relation to other factors governing plant growth varies greatly under California conditions, and since any factor acts in a depressing way on plant growth proportional to its nearness to the minimum, it is obvious that water alone can only increase plant production up to a certain limit. Should too much water be applied, then another factor, air, is rapidly coming into the minimum. Hence we find that, under some circumstances, irrigation water does more harm than good to crops.

As different soils vary greatly in their pore spaces which normally govern water-holding capacity and percolation, it is evident that a quantity of irrigation water making water the minimum factor in one soil will provide an optimum water content under divergent soil conditions.

The water capacity of different irrigated soils varies greatly, reaching from 35% by volume in a sandy soil to 65% in a heavy soil. As the rapidity of water percolation through soil is in inverse ratio to the water capacity of the soil, it is at once clear how variably plant growth may be affected by the same amount of water under varying soil conditions.

A soil column very often represents many structural combinations in its composition. A light soil may be either underlain or overlain or interstratified with heavier soil or clay or even gravel. The importance of such structural differences in the percolation of

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water is shown in the following table of a light soil underlain by clay.

| Soil type. | | Layer depth in cm. | Pressure of water. | Amt. of water percolated in 10 hr. in litres. |
|---|---|---|---|---|
| Quartz sand | Kaolin in layer of | 0 | 100 | 240.64 |
| | " " | 1 | 100 | 29.28 |
| 0.25-0.50 mm. | " " | 3 | 100 | 24.39 |
| | " " | 5 | 100 | 2.05 |
| Quartz sand | Clay loam in layer of | 0 | 50 | 366.56 |
| | " " | 1 | 50 | 7.43 |
| 0.5-1.0 mm. | " " | 3 | 50 | 0.22 |
| | " " | 5 | 50 | 0.14 |

It is readily seen that a layer of clay or clay loam, even if relatively very shallow, exerts a marked influence upon the permeability of irrigation waters and may retard the percolation of water almost 100 per cent.

The capillary power of a soil is also of great importance in irrigation practice. It differs greatly in different soils and is found to reach in peat soils 15 to 18 ft., in clay 3 to 4 ft., in loam 1.5 ft., and in sand 8 in. to 1 ft. The rate of the capillary movement in a given time also is very different, being most rapid in sandy soil and slowest in clay soils. Having found this rate, which has to be established by experiment in any given soil, together with the rate of evaporation from soil and plants, it is then a simple task to calculate how far the subsoil moisture can be depended upon to adequately supply a given crop with water. It can be seen, then, what an important rôle the physical properties of a given soil exert upon the movement of water, and that the amount of irrigation water and frequency of irrigation are directly dependent upon the physical properties of the soil.

The amount of available moisture in the soil is also widely different. A light soil may have a water content of 2% and yet contain enough water to sustain plant life, while another soil of heavier structure may contain 25% of water and the plants in this soil will die from lack of water.

Where the value of water is high the protection against excess percolation and evaporation is very important. On the other hand, in those localities where an abundance of cheap water exists, the problem of conserving the pore spaces in the land is of much greater economic importance and is one that is ever present in all irrigated districts.

Perhaps the most serious handicap which the agricultural engineer meets is in inducing the average user of irrigation water to recognize the above dominating factors in irrigation practice. It is, therefore, no unusual thing to find, upon examination of irrigated lands, new and old, that one man is using an excess of water, while within a short distance and under identical conditions another user is applying too little water. This condition of affairs exists more because of the lack of accurate data, and also to that inertia which prevents most of us from changing over from old-time methods, than to any consideration given the subject by the user along economic lines.

## A SIMPLE TYPE OF SECTION FOR MOVING A SHOVEL OVERLAND

A. L. Van Dyke, of Woodstock, N. B., has given a description of a method, which he has used with much success, for moving a 70-ton shovel across country. Mr. Van Dyke states that when a shovel is to be moved for any distance it is most important to build sections instead of using rails, ties, and bridles.

Three 33-ft. sections are sufficient. Sixty-pound rails have been found suitable. These have not been found too light for the service. The rails are spiked to ties, of 3 by 6-in. hard pine, spaced about 8 in. apart. Beneath the rails, 3 by 12 or 16-in. hard pine planks are spiked to the bottom of the ties. To serve as runners, 1 by 3 or 4-in. strips are nailed beneath the planks.

In order to make the sections stiff, blocks should be put under the rails between the ties and spiked fast on top of the planks. The rails should be allowed to stick out from 4 to 6 in. over each end of the section, in order to provide clearance for easy connections. In making connections with the sections, use straps similar to those used with the ordinary 6-ft. sections, but instead of using a bolt and nut, use a spike with a key slot ¾ by ⅛ in. and a wedge-shaped key. This will prove simpler and more effective than bolts and nuts, as the threads are constantly being knocked off. To both ends of the fourth or fifth ties on each end of the section, fasten a ½ by 3-in. strap bent in a V shape.

Use two teams, one to pull the sections back from the rear of the shovel 6 or 8 ft., and the other to haul them around and in front of the shovel. Eight men with bars are sufficient to throw the section over in line, so connections can be made. Two others should be used to pull out and put in the bolts. In this manner, a mile to a mile and a half may be made in 10 hours without unduly driving the men. With 80-lb. rails, bridles, and ties, the work is very strenuous, and as a rule the men are exhausted by noon, consequently cutting down the progress in the afternoon. A turn can be made easily by using a 6-ft. section between the two long sections. Another advantage of the long section is that a shovel is not as liable to get off the track as is the case with ties and bridles. And even if this does happen it may be pulled on again easily by fastening a chain around one or two of the ties and the other end to the propelling chain. Jacks have rarely to be used.—*Excavating Engineer.*

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# Methods of Starting Active Safety Work in Different Plants*

By F. P. SINN

Each of us has a different problem to solve in starting an active safety campaign, depending upon the character of the individual industry and on many local conditions. The railroads and some of the public service corporations have a different and much more difficult problem to solve, because with them the public must be the first consideration.

There are certain underlying principles which I believe are necessary to any successful 'Safety First' campaign, and by way of illustrating these fundamentals, and of pointing out their application to various conditions, I will give you a brief outline of the 'Safety First' campaign started at the Palmerton plants of the New Jersey Zinc Company (of Pennsylvania) in the summer of 1911.

The two plants are situated about four miles apart. One of them occupies 122 acres and the other one 93 acres. More than 2000 men are employed in all. The operations carried on are metallurgical ones, and as crude materials only are produced, the tonnages handled are large in proportion to the men employed. Two-thirds of the labor is of foreign birth, and comes to the plants entirely unskilled, and with little or no knowledge of the English language. The large tonnages of material handled require the presence of handling machinery and railroad equipment. The maintenance of this equipment, and of the furnaces and buildings, necessitates the operation of an iron foundry, and of a rather complete set of shops. Native labor is employed almost exclusively for this kind of work, while the furnace work, and all of the heavy and trying kind of manual work, is done by the foreign labor.

The superintendent of the plants selected in the summer of 1911 one of the department heads as chairman of a Safety Committee, which committee was chosen by the chairman and superintendent from the tops of the various department organizations—the five members selected being, with one exception, heads of departments. This committee decided to meet at a regularly appointed time each week for the purpose of discussing and deciding upon safety matters.

A campaign for the prevention of accidents, and for the improvement of the working conditions in general about the plants, was planned and put into operation. The plants had been laid out from the beginning on broad lines, and there were practically no crowded or cramped conditions to be contended with. Fence guards had always been provided about moving machinery, where workers were present, and railings on trestles, etc., were in common use. Unsafe practices were avoided, and the question of accident prevention had always received more or less attention. However, the committee found a lot to be done, and, realizing the importance of obtaining the hearty coöperation of all members of the organization, from the department heads down through the foremen to the labor bosses, and the laborers themselves, addressed a circular letter to all, advising them of the efforts which were to be made for the prevention of accidents and for the improvement of working conditions, and asking each member of the organization for his individual help and support. Notices were posted about the plant, requesting that any dangerous or unsanitary conditions in the plant be reported to the Safety Committee. Suggestion boxes were distributed about the plants, with forms and pencils attached, so that proper means of communication could be had between the individual workmen and the Safety Committee.

A careful study of the practice of carrying on safety work at other plants was made, and the coöperation and help received from all quarters was most encouraging and commendable. For help and suggestions received, we were indebted most to the Illinois Steel Co., to the Midvale Steel Co., to the Aetna Life Insurance Co., to the Pennsylvania Railroad, and to the American Museum of Safety.

The work progressed rapidly, and grew to such proportions that it was found advisable to select some one who would report to the Safety Committee and whose whole time and attention could be devoted to this work. A man who had had a wide experience in the zinc smelting business, and in handling men, was selected for this work, and was appointed Safety Inspector. The duties of the Safety Inspector were as follows:

1. To make inspection trips about the plants, reporting to each chief of department any dangerous places or practices existing in his department, on a form provided for that purpose.

2. To see that all suggestion slips made up by employees were brought to the attention of the chief of the department in which the danger existed.

3. To make a study of and offer suggestions for the elimination and protection of all dangerous places reported.

4. To investigate all accidents and to make suggestions to the chief for the prevention of such accidents in the future.

5. To educate the workmen in the 'Safety First' habit by calling their attention to the danger connected with their work.

6. To keep in touch with the foremen throughout the plants, so that 'Safety First' principles would be

*Address read before the National Council for Industrial Safety, February 20, 1914.

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always uppermost in their minds when giving orders to their men or when planning their work.

7. To bring to the attention of the Safety Committee all cases where the suggestions as recommended by the Safety Inspector were not properly carried out by the department chiefs.

Pay-check envelopes were inaugurated, and different safety slogans were printed on the envelopes, so that on every payday this question of the safety of all was brought to the attention of each individual workman. It was also hoped that these pay-check envelopes would be carried home, and come to the attention of the dependents of the wage-earners, so that the importance of safety would be discussed in the home.

To further stimulate the 'Safety First' movement, and to show the men how widespread was this movement throughout the country, an illustrated lecture was given at the Neighborhood House in Palmerton by Dr. W. H. Tolman, Director of the American Museum of Safety. This lecture was delivered in February of 1912, and was attended by over 225 men, including department chiefs, general foremen, foremen, and workmen. All who attended this lecture were given a clear understanding of the work which was being done throughout the country for the prevention of accidents, and were thus better prepared to lend their assistance and to help in the development of the safeguarding of our own plants. Toward the end of 1912, suggestions had been received and recommendations filed covering many of the dangerous places and practices in the plants, and the work of protecting and safeguarding these places was well in hand.

By this time it was apparent to all in the plant that the management was in earnest in carrying out its policy for the prevention of accidents. The installation of numerous safeguards, of swinging gates at dangerous crossings, and of the complete covering of many of the moving gears, was an ever-present reminder of the Company's attitude in the matter.

It was felt at this time that if the carrying on of the work could be done by the men themselves, the interest in the 'Safety First' methods would be increased, and the education of the men themselves could be more readily taken care of. With this end in view, it was decided to do away with the Safety Committee first appointed, and to appoint the Safety Inspector as permanent chairman of a Workmen's Committee. This committee was to be selected from the workmen themselves. At this time a permanent secretary of the committee was appointed to aid the Safety Inspector in his work and to handle all routine and clerical matters. The new committee appointed was made up of eight members selected from the various departments in the works. It was so arranged that two of these members should retire each two weeks, and two new ones should be appointed each two weeks to take their places. In this way, after the first selection, each member appointed to the committee would serve for a period of eight weeks. At the start, foremen and men fairly well up in the organization were selected, but at this time the workmen themselves are well represented. As a result of this method of carrying on safety work, there are trained safety men in each department of the plants who are continually on the alert to prevent accidents and to encourage the spirit of caution and safety among the men.

With the organization of this committee, the responsibilities of the Safety Inspector, as chairman, were materially increased. He now reports directly to the Superintendent and is responsible to him for the safety work.

The new committee meets every Friday, and the greater part of this day is given over to safety work by the men on this committee. At the start the committee spent most of its time in making tours of the plants, then followed suggestions and recommendations for overcoming the dangerous places which were observed. As the most dangerous places were soon taken care of by suggestions for their protection, and the work of guarding these places progressed, the committee began, during the early part of 1913, to devote one-half of its meeting day to this part of the work and the remainder to a consideration of other features. Accidents occurring during the previous week were taken up and discussed, and suggestions made for preventing their recurrence. Several hours of each meeting day are now spent in first-aid drills, bandaging, manipulation of the pulmotor, and practising the prone method of resuscitation. These drills were started under the direction of the Surgeon in Chief of the Palmerton Hospital.

Safety work, to be carried on successfully in any plant, no matter what its size, must have the enthusiastic support of the management. This support must be apparent to all in the works organization, and in large organizations it is no small problem to accomplish this. In such cases the various department superintendents must necessarily represent the management. Therefore these are the men who must first fall in line with the safety movement. The problem is one of education, from the top of the organization all the way to the bottom, and each step in the educational work must be accomplished surely, even though slowly. It is a mistake for any management starting this work to expect to get the enthusiastic support of the men down the line if there are department superintendents and foremen here and there about the plant not in sympathy with the work.

If a superintendent growls about the expense of a guard, his foremen will soon be telling him how this and other guards interfere with production. The operators will catch the same spirit only too quickly, and soon an accident will happen and the investigation following will point out that a guard had been provided to prevent such accidents, but that the injured man had neglected to use it. In certain cases guards that have been carelessly discarded, or not properly

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attended to, have in themselves caused accidents. Thus, after your plant is protected, the very safeguards which you have installed may add to the dangers of the plant if the men are not in sympathy with the guards, and if proper inspection does not follow to insure that they are kept in good condition.

To obtain and keep the active support of your men in the 'Safety First' movement is not easy, but it is practically impossible if the men higher up are not individually working for it. Too much emphasis cannot be placed on this underlying principle in starting an active campaign for 'Safety First'; and, wherever possible, your scheme for carrying on the work should in some way embody the education in 'Safety First' methods of the men at the top of the organization as well as of those at the bottom.

Another important feature to be kept in mind is that those most accustomed to certain dangers are, as a rule, the last to recognize those dangers. Any scheme for accident prevention which confines the inspection for safety of any department to men in that department will be defective on this account. It is usually the man unaccustomed to a particular line of work being done, and unfamiliar with the surroundings, who first sees the dangers at hand, and it is often he who has the best suggestions to offer to remedy the dangerous conditions. Whatever remedy is decided on, however, must fit into the particular conditions at hand and must be entirely satisfactory to the man in charge of the work in question.

Many of you have plants which are of such size as not to warrant the appointment of one man, or more, all of whose time shall be devoted to safety work. In many cases the master mechanic of the plant naturally falls into the position of safety inspector. Perhaps one hour a day or several hours a week devoted entirely to safety matters will take care of this situation. As the safeguarding of the plant progresses, and the education of the men becomes important, it may be advisable to have a committee of workmen go over safety matters, with the master mechanic as chairman of the committee. The size of your plant, the number and character of your employees, and the organization under which you operate, must necessarily regulate the method you use for carrying on your 'Safety First' campaign. The launching of a Workmen's Safety Committee should be done with considerable caution, and ample preparation should be made for it. In no case should it be done until the men can see, from actual work accomplished, that the company is in earnest in its endeavor to prevent accidents, and that it is doing its share. The man at the head of any workmen's committee must have, first of all, the respect of the members of the committee, and he must have their confidence. He must also have the force to properly guide the recommendations of the committee. The reckless expenditure of money for safeguards which may be the result of foolish competition between members of the committee, to see which can make the most suggestions, cannot result in the successful carrying out of any campaign, and the interest of the men themselves will soon lag.

Those of you who are doing mining work may find that the conditions are such as to require a very different and more strenuous method of procedure. Skilled men are usually employed for underground work, and to be cautious and careful of their own and others' safety is considered one of their first requisites. If, however, skilled men are not available, and those employed do not speak the English language, then the safety problem is greatly complicated. The education of the men as to the dangers of the work, and the proper ways of guarding against such dangers, must be carried on in some simple and effective manner. Such men must be taught to consider the safety of very move that they make. Photographs of the right and wrong ways of doing things, with short descriptions in various languages, may sometimes be used to good advantage. Prizes offered at regular intervals, to be given to the gang having the best accident record, may also, in certain cases, be employed to advantage in obtaining the proper results.

We hear and read a great deal about the necessity for educating the workmen in order that accidents may be prevented, and it seems to be a well established fact that safeguards themselves will prevent not more than one-third of the accidents which happen. There is a tendency, however, on the part of the workmen, and a perfectly natural one, to believe that they do not have to be told not to get hurt, as they are just as much interested in keeping alive and well as we are in having them so. Every move in the educational work, therefore, should be made with this point of view in mind.

The management, and not the employee, is responsible for dangerous methods and practices. If accidents are due to such causes, it is not fair to place the blame with the individuals who have known no other way of doing their work. In changing such methods and practices, there is a chance to ask the employees frankly for their assistance and coöperation. The change will be for the benefit of all, but the employer must not appear to be shifting to the employee any of the responsibility for the previous condition. The management must take active steps to see that recklessness is not tolerated, and that men who continue to be reckless are discharged. Thus it is to help remedy bad conditions that the coöperation and help of the employees is wanted, and not to share the blame or responsibility for such conditions.

A central employment bureau, at which all men are hired; the examination of employees by a physician, so that they are placed at the kind of work for which they are best fitted physically; a careful record of all injured employees, showing the number of times each has been injured, the extent of the injury, and circumstances of the accident; the maintenance of an emergency hospital—are all worthy of consideration.

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# Unconformities and Overlap and Their Effects on Oilfields

By DORSEY HAGER*

It is interesting and instructive to consider the effects of geologic changes upon oilfields. Anticlines and domes are well understood, but the effects of faults, intrusions, and of unconformities and overlap, are not so well comprehended by the practical operator, or even petroleum engineers. In this paper, the discussion deals particularly with unconformities and overlap.

### Definitions

**Conformity (after Geike).**—Where one series of rocks, whether of aqueous or igneous origin has been laid down continuously and without disturbance upon another series, it is said to be conformable.

**Unconformity.**—Where one series of rocks has been laid down upon another series, and there is a break in the continuity of the two series due to the fact that the lower series has been exposed to erosion, or to tilting and to folding, the contact of the two series is called an unconformity.

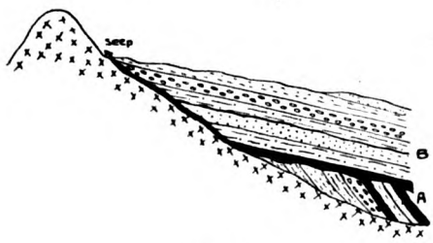


Fig. 1.

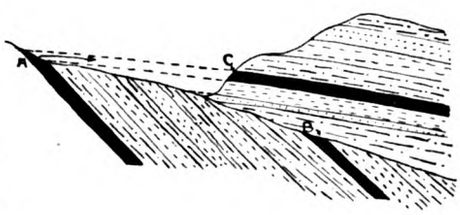


Fig. 2.

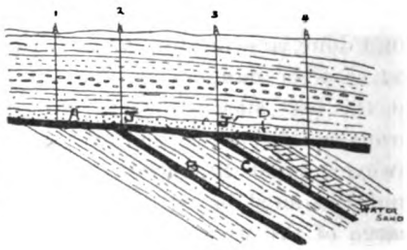

Fig. 3.

### Classes of Unconformities

There are two principal classes of unconformities.

1. Erosional (see B in Fig. 1).
2. Angular (see A in Fig. 1).

Where the lower beds lie at a slight angle or are parallel to the upper beds, and the top of the lower beds has been eroded, the unconformity is called an erosional unconformity.

Where the lower or upper beds are tilted at a very perceptible angle to one another, the unconformity is called an angular unconformity.

Suppose tilting or folding to occur under the ocean without there being sufficient elevation to bring the beds above the surface of the water. If, then, sediments are deposited upon these tilted or folded beds, they will lie at angles to them. There will then be angular contacts between the beds. Such contacts will be angular unconformities.

Where the beds have been tilted, eroded, and later beds been deposited upon them, there is a combination of erosional unconformity and angular unconformity. For all practical purposes such an unconformity may be called angular.

Sometimes erosional unconformities are classified as disconformities, and angular unconformities merely unconformities. In this paper, however, the definitions above will suffice.

### Causes of Unconformities

Suppose a mass of sediments to be laid down along a sea coast forming a slightly inclined blanket of sand, clay, or shale, etc. If the coast sinks, numerous beds form one upon another; if the coast rises, the upper beds are exposed to weathering, that is, the action of winds, rains, and streams, which carve the surface into gullies and cañons. If the coast sinks again, then other beds form upon the eroded surface. The contact between the new beds and the old is the unconformity. The rising and falling of coasts is due to shrinkage of earth.

### Effects of Unconformities.

Unconformities may act favorably or unfavorably or be neutral in their effects upon oilfields.

**Favorable Effects.**—1. Unconformities may form good reservoirs for oil (*a*) by bringing higher porous beds in contact with petroliferous beds below, or (*b*) by sealing in the lower petroliferous beds by the impervious beds above.

2. Unconformities may assist migration of petroleum. Unconformities tend to preserve reservoirs for petroleum. Especially where the covering of the lower beds is compact shale, it may keep the oil from migrating and confine it to the lower reservoirs (see B, Fig. 2). If petroleum forms in the upper beds and is underlain by porous sands, then it may travel downward instead of upward. This would be the case were water absent from the upper part of the lower formation.

In places the beds along contacts between the upper and the lower formations act favorably as reservoirs for petroleum. If the overlying beds are porous, then the petroleum rises from the lower beds and fills the upper sands with oil. Thus in the Fullerton field the petroliferous shale is overlain by the Fernando forma-

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tion. Oil collects at the base of the Fernando; at Coalinga the Vaqueras formation overlies the Tejon and seems to have derived its petroleum content from it. Where two sands join, as at $J$ and $J'$ in Fig. 3, a condition is set up that is perhaps responsible for some of the great productions like that of the Lakeview gusher, as suggested in an article by R. P. McLaughlin.

Unconformities in conjunction with overlap assist in the migration of petroleum from lower to upper strata.

**Unfavorable Effects.**—Unconformities may (1) deepen sands; (2) complicate drilling; and (3) make surface indications unreliable.

Unconformities sometimes increase depths to oil. Suppose two sands in Fig. 3, lying at an angle one

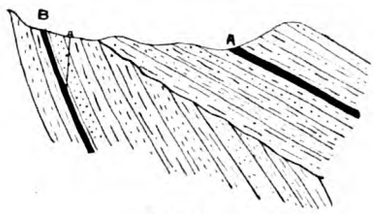


FIG. 4.

to the other; the distance between the two sands constantly increases. Then a well drilled at 1 will strike one sand, at 2 a well will strike two sands. At 3 the B sand lies much deeper than at 2. This thickening of beds makes the depths to oil greater. The effect upon the drilling records or logs is perplexing unless the unconformity is known. Well No. 1 shows but one sand; well No. 2 shows two sands and a marked similarity in the logs down to the unconformity. Below the contact the four wells, 1, 2, 3, and 4, all have different logs. If a water sand occurs at 0, then it will be necessary to cement off the water or lose the lower sands by water flooding. At 3 such a condition is not found. The logs of all the wells will, however, be different. Such a condition will be misleading unless the geology is carefully considered. Such conditions explain several questions that have come up in regard to wells in the Maricopa and Midway regions.

**Makes Surface Indications Unreliable.**—Where such unconformities occur there may be no indications of the outcropping or exposure of lower sands. Sands $A$ and $C$ may show as in Fig. 2, but $B$ will be completely hidden. If oil has not migrated from $B$ to upper beds, then one may strike no seepages or sands at the outcroppings, but still obtain a plentiful supply in lower sands.

**Neutral Effects.**—(1) Unconformities may have no effect when there are no productive sands lying below the unconformity, and (2) where the petroliferous formations occur beyond the unconformity.

In some cases unconformities have no effect, especially when there are no productive sands below the unconformity as in $A$, Fig. 4. On the other hand, where a sand as at $B$ occurs beyond the unconformity, the unconformity has no effect on the occurrence of oil.

**Mapping Unconformities.**—Unconformities are shown on geological maps by contact lines marking formations one from another. The contacts may be between conformable or unconformable beds. In Fig. 5 there is shown the mapping of a contact between several formations.

**Overlap.**—Where one series of beds is laid down upon another, while the coast is gradually subsiding, the upper beds will continuously encroach upon the land and overlap the lower beds. (See Fig. 1.) In overlap, there is no break in the continuity of the strata. Where, as in Fig. 1, the overlapping strata also overlie the lower tilted beds unconformably, petroleum may migrate from the lower beds to $B$. From $B$ the oil works its way upward by traveling along the contact of the upper beds and the granitic rocks. Such migration would require a great while, but geological periods comprise many thousands of years, so that the time is not limited.

In many fields it is hard to understand how petroleum reached the upper beds from the lower ones. Since erosion has cut away any visible connection, the following sketch will make plain how migration may have occurred (see Fig. 2). In this case the oil in $A$ migrated to $C$ before the connection between $A$ and $C$ had been eroded.

In proved fields, unconformities are shown by making cross-sections as in Fig. 5*b*. The symbol ~~~~~ generally denotes an unconformity.

## Summary

Unconformities may be favorable, unfavorable, or neutral in their effects on oilfields. They assist in

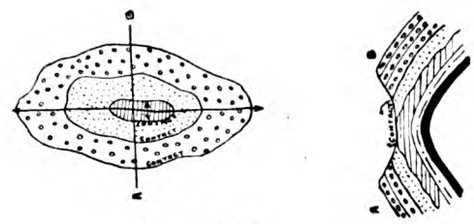

FIG. 5.

accumulating oil and assist in its migration. They cause deeper drilling and a complication of drill logs. In some cases they have no effect at all.

## Conclusion

Unconformities are not mysterious subjects at all, but a detailed study of each field is required to tell just how such unconformities affect it. It is the writer's opinion that the migration of petroleum from its original bed or beds is more the result of unconformities and overlap than of any other causes. Faults and diffusion through the beds may also have some effect, but it seems to me that the great changes were due to unconformities combined with overlap.

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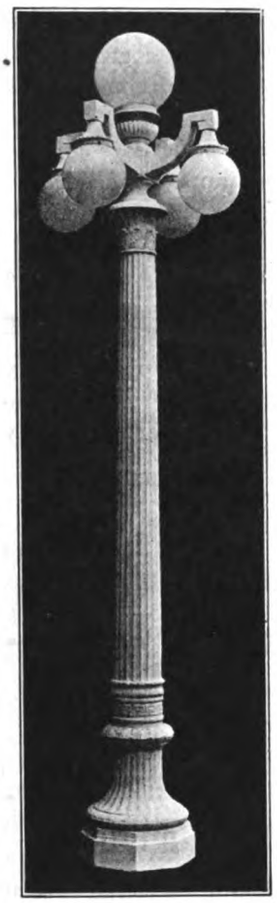
# Ornamental Mazda Street Lighting

By T. M. STATELER

It is not the intention of this article to deal with this subject in a very comprehensive manner, but merely to outline in a general way what is being accomplished on the Pacific Slope and to show the vast improvements that have been made in the matter of suitable street standards and increased illumination due to the present high efficiency Mazda lamps.

President Lincoln, when asked his opinion of a certain book, replied: "For the kind of people that like that sort of a book, it is just the kind of a book for that sort of people." So with ornamental street lighting; it is welcomed where people want that sort of lighting, and the question naturally arises as to the cost of installing and operating such a system as seems most to fit that particular municipality. A system that would be entirely appropriate for a town of four or five thousand people would be severely criticized and would not necessarily be suitable if installed in a much larger city, and *vice versa*; so in planning an ornamental street-lighting system, not only the needs of a community, but the esthetic and financial side of the question must be considered as well, and each case treated according to its individual requirements. When the importance of this subject is considered, its wonderful development is perhaps one of the most remarkable features of commercial electricity of recent years.



UNION METAL LAMP STANDARD.

It is only a very few years ago that the first ornamental system was introduced, and it was then looked upon as an expensive luxury that would probably be used only for small installations put in privately by individuals or for the exterior lighting of public buildings. The idea that this form of lighting would be adopted generally to light entire cities was not appreciated or considered at that time. Cluster electrolier lighting has, however, passed its experimental stage and demonstrated that good street lighting pays in dollars and cents, pays in attracting business, pays in added real estate values, in heightened civic pride, and animates streets which otherwise would die at sunset. Conspicuous examples of private enterprise outrunning the public administration of affairs is shown in the present movement for better street lighting which has spread over the entire country with astonishing rapidity during the past few years.

The majority of the new installations are due wholly or in part to private funds, and it is perfectly safe to assume that private funds would not be expended for public utilities unless the benefits to be derived were unquestionable and adequate. That good street lighting, either for residence or business streets, increases their value by making them more desirable, needs no argument. Good street lighting, more than anything else, gives to a district or to a municipality an air of progressiveness and prosperity that perhaps nothing else can and has proved to be just as essential as well paved streets. Our cities are largely judged by impressions. They may have every natural advantage, yet if they be unattractive, dirty, and gloomy, their development will be slow. When they do develop, the first impetus will be gained by changing their appearance for the better, and in that change good street lighting plays a most important part.

The lighting of business and residence sections must be governed by entirely different points of view. Business or commercial lighting must be brilliant, so that people will be attracted; residence lighting, on the contrary, must be considered largely from a utilitarian standpoint. For commercial lighting in small municipalities a festive form of lighting is favored; *i.e.*, the 3 or 5-light cluster being most popular. For large cities single units of high efficiency are most inconspicuous and economical, and can be made to harmonize with surroundings more advantageously than cluster lighting. The latter has the effect in large cities of 100,000 population or over to clutter up the street,

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while the single unit carrying a type *C* high efficiency Mazda lamp lends dignity to the street in the simplicity of its design.

There seems to be no standard installation to be adopted, different cities installing vastly different systems, both as to the size of Mazda lamps, style of electroliers, method of lighting, and control. This is due largely to the dominant control of city officials or city engineers, and the result is a rather chaotic lot of systems, of which but few can be distinctly referred to as examples. It is, of course, natural that all systems should not be alike or even approximately so, as each community tries to attain some individuality, but in the absence of some criterion to follow, the result has been deplorable in a great many instances. The matter of the manufacture of street standards has inflicted upon longsuffering municipalities some of the most atrocious street fixtures that misplaced ingenuity could devise, esthetic features having been entirely lost sight of in the greed of the manufacturer to turn out standards of enormous weight at so much per pound. Imagine purchasing the fixtures of a fine house or theatre by the pound. Several of the largest cities on the Coast are equipped with hundreds of the most impossible street standards; one may be very fantastic in design, flowered all over with a multitude of meaningless scrolls; another city has striven to the opposite, and a standard of severe lines advertised as pure 'Mission' thought to be eminently appropriate. The mayor of one of the largest cities in this state remarked to the writer, not very long ago: "I shudder every time I pass one of our electroliers; for could anything have been designed more hideous or out of keeping with the surroundings?"

It must be assumed at the outset, and this is an item that seems to have been almost entirely lost sight of, that street standards are more conspicuous by day than at night. The architectural point of view has been relegated to the background in the feverish haste to erect something that would support one, three, or five lights. At night the cluster of lights is distinctive and the support is inconsequential, but in the glaring light of day some of the deplorable effects produced are only too apparent even to the disinterested casual passerby, and to the interested individual who takes a pride in his city, a feeling that the community's money has been frittered away in an attempt to accomplish something before any effort was made to ascertain the needs of the community. These results have largely been due to the enthusiastic property-owner and tenant who was doubtless the originator of this form of lighting and the solicitations of salesmen whose greed overran their ideas of what was appropriate and beautiful. It is, of course, deplorable to feel that all architectural ideas have in some cases been abandoned. In one installation on this coast, a system that cost the property-owners upward of $100,000 is being derided and condemned on all sides, and its demolition is now under consideration. This particular installation is not over eight years old. Of course, this is not wholly due to ignorance, but what was appropriate when the system was first installed, and was perhaps pleasing then, is now criticized owing to the new designs of standards appearing and the natural trend of the human mind developing by thought and education the idea of 'The City Beautiful.' An ornamental lighting system advertises your business and your municipality; your lamp standards, your globes, proclaim you a community of taste or 'any old thing is good enough.'

Along these lines, in recent years there has been developed a line of street fixtures that are genuinely 'ornamental.' They are a distinct departure from the obsolete standards that have been in vogue all over the country. Their classic lines please the most fastidious. These standards are made on the models of Greek columns, the rules of which were worked out by Phidias and Ictinus in the days of Pericles when Athens was the most beautiful city the world had ever seen.

In the British Museum, in Italy, and in Greece you can see remains of columns carved by the Greeks 400 years B. C.

Union lamp standards are made of pressed steel, pressed copper, or pressed bronze, and represent a unique and distinct development in ornamental street-lighting specialties. This invention makes the construction of a tapered fluted column from sheet metal a possibility for the first time, and lends itself admirably to the manufacture of lamp standards requiring classical lines and clean-cut, graceful contours. A sheet of steel, copper, or bronze, of sufficient gauge to insure perfect strength, is formed into a plain tapered column of proper architectural proportions. Another plain column of the same size and shape constructed of special non-oxidizing steel is forced inside the first. By means of special machinery, the double-tapered column is then fluted in accordance with either the Doric or Corinthian orders of architecture. The double, and in the case of copper and bronze triple thickness of material, together with the fluting, insures a metal cross-section equal to the depth of flute and increases by several times both the compression and lateral strength of the column. Pressed steel standards are fitted with cast iron bases and heads; pressed copper with cast iron heads and bases painted with bronze paint to match the beautiful mottled copper shaft.

In view of the past prevailing cost of ornamental street-lighting standards, it is surprising to learn that pressed steel standards can be furnished for considerably less than the price of other types of similar design, and pressed copper having all the appearance of bronze and presenting a rich appearance and lasting for generations for comparatively little more. Pressed bronze can be furnished at a price that for the first time makes the use of this metal a commercial possibility for street-lighting purposes.

The sectional construction gives great flexibility in design. Bases, shafts, and heads are interchangeable,

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so that innumerable combinations can be made. This means that clusters can be easily changed to a single light, and *vice versa*. For example, the advent of the type *C* Mazda lamps means that many cluster standards are being changed to single lights. The sectional construction of these electroliers makes it particularly easy to remove the cluster head and substitute a single light capital and globe holder. In like manner, any future lighting development or improvement can readily be taken care of. Thus a service is offered in flexibility that must appeal to everyone.

Union metal standards are erected exactly after the fashion of the steel frame supporting the modern sky-

SINGLE LAMP MAZDA LIGHTING STANDARDS AT FOREST HILL, SAN FRANCISCO.

scraper, showing that their construction features are along scientific lines. A cast iron base is first anchored solidly to a concrete block with steel anchor rods. After the rods have been allowed to set in the concrete for 24 hours, the steel column is put on and the whole standard bolted together with three steel tie-rods which run to the top of the standard. This mode of construction makes it impossible for any jar or severe shock to upset one of these electroliers.

The cost of an ornamental lighting system varies widely with latitude and longitude. The price of labor and material, the manner in which current is distributed, control, the nature of sidewalks and paving to be torn up and relaid determines cost. One city may select expensive standards and lay distributing lines in clay conduits employing lead-sheathed cable insulated for high voltages. Another will adopt a low-priced standard and lay rubber-covered wire in galvanized conduit.

The cost of maintaining a system also varies widely. A large proportion of installations are paid for by flat rate per standard, varying from $1.70 per month for 200 watts to $5.10 for 220 watts. One city pays a meter rate of 2¼c. per kilowatt-hour to its municipal plant. The average meter rate is 3c. when the entire system has been put in without expense to the central station, the municipality renewing lamps and globes.

The average five-light cluster should carry five 100-watt Mazda lamps, one upright and four pendant, as the maximum efficiency of illumination is to be secured by this arrangement. The city of Vallejo has a most excellent installation of this description, standards being spaced 100 ft. apart and opposite. Some cities feel that they cannot afford to supply this amount of current, and in this event one 100-watt Mazda and four 60-watt Mazda lamps provide very excellent illumination. The city of San Rafael has ninety-seven Union metal copper standards, erected on the principal business streets, spaced about 100 ft. apart, carrying Mazda lamps to the amount of 340 watts per standard. The result is that this city has the best lighted business streets in the state of California, and there is perhaps no better illustration of cluster lighting in the country than can be seen in this enterprising municipality.

From photometric tests taken of an installation of 500 watts per standard on a street 50 ft. wide, the standards being 100 ft. apart, an average of 0.175 foot-candles was secured, the readings being taken at a 36-in. plane, taking into account only the illumination produced on the roadway. Experiments are now being made with the new type *C* high efficiency Edison Mazda lamp of wattages ranging from 500 to 1000 watts, and a number of installations is planned of one-light standard carrying a 750-watt lamp, which furnishes approximately 1265 candle-power. It is proposed to put these lights on standards from 14 to 16 ft. high, according to the character of the buildings on the streets, and spaced from 80 to 100 ft. apart. This type of lighting is most excellent for cities of large size and should prove immensely popular.

These systems are always wired underground, the wires being laid in galvanized conduits, either being lead sheathed or rubber covered. A rather radical departure here in California in recent years was the wiring of the most extensive electrolier system in the United States (some 4400 standards) with ordinary rubber-covered wire. The cost of this installation would have been prohibitive employing lead-covered cable. While some electrical engineers are prone to criticize this method, the fact remains that this extensive system of over 110 miles of pipe and wire has now been operating three years and has given perfect satisfaction. Where reasonable care is exercised in installing rubber-covered wires, there is no reason why they should not prove satisfactory.

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Usually the multiple system is the cheaper to install. In the first place, the cost of lamps is less; in the second place, series sockets with film cut-outs are much more expensive than the receptacle designed for carrying lamps wired in multiple. In a series system, more care must be employed in installing the underground system and lead-sheathed cable invariably used. It is also necessary to install expensive sub-station apparatus to provide means for current regulation. In a multiple system the lamps must be extinguished either singly or in groups, with reference to the standards; while the advantage in a series system is that they can be controlled as a unit from some distant point. Methods of multiple control have been improved in recent extensive systems by constructing independent primary circuits from sub-station to individual banks of transformers supplying the electroliers, and the different circuits controlled and metered at the sub-station. The latter method is perhaps the most satisfactory that can be employed. Seattle employs a low-voltage lamp with a compensator in the base of each electrolier, but there is no decided advantage in such an arrangement, and it is expensive and cumbersome besides.

Proper glassware plays a very important part in ornamental street lighting, and improvements in this line have kept pace with those in electroliers. To the ordinary glass of commerce manufactured from silicate of soda, lime, lead, and potash; carbonate of calcium, red oxide of lead, fluorspar, feldspar, fluoride of aluminum, phosphate, etc., is added to the base proportion to produce 'Opal' glass. The result is a beautiful glass approximating pure marble in appearance, disguising entirely the filament of the incandescent lamp and diffusing the light uniformly in all dirictions. While there is naturally some absorption of light, this absorption should not exceed 20%, and does not in the globes manufactured especially for erection upon street standards.

Perhaps the majority of installations that have been made the country over were the results of a campaign inaugurated by some local Chamber of Commerce or Business Men's Association who were progressive and public spirited enough to see the advantages in this mode of street lighting. Here in California, when this system first started, this method of raising funds was largely in vogue, but at the present time these installations are being put in under the Public Improvement Act of 1911 and paid for by direct assessment of the property-owners. The inaugural mivement is usually started by the Chamber of Commerce or the merchants in the district where these lights are desired. The method of paying for such an improvement works no hardship upon any particular property-owner and equalizes the expense throughout, and it will no doubt result in the abandonment of plans made by private individuals where the money is collected by voluntary subscriptions. This latter plan has its disadvantages in view of the fact that some unprogressive property-owner may decline to pay his share of the expense, and if the installation is put in regardless, the adjoining property-owners are compelled to pay his *pro rata*. Where the work is ordered by the city and done according to law, such contingencies can never arise.

In conclusion. It has been truly said: "That in popular government, abuses are the penalty of neglect on the part of the governed. Civic pride is the surest step toward better municipal government. Anything that adds to the general attractiveness of a city, excites interest in its affairs and fosters public spirit and civic pride. Every citizen should be able to 'point with pride' to his own city; but how shall he do this when he sees such a woeful deficiency by poor public lighting. He may not be able to pass upon the relative merits of its public library or the architecture of the public buildings, but public lighting is a thing of so conspicuous and evident a nature that there is no escaping the odium of an unfavorable comparison."

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**Several** large contractors use two exploders instead of one when making large shots, so that in case one exploder misses, they can connect up the other one and fire. This saves time and expense otherwise lost if they had to draw the tamping and reprime the shot.

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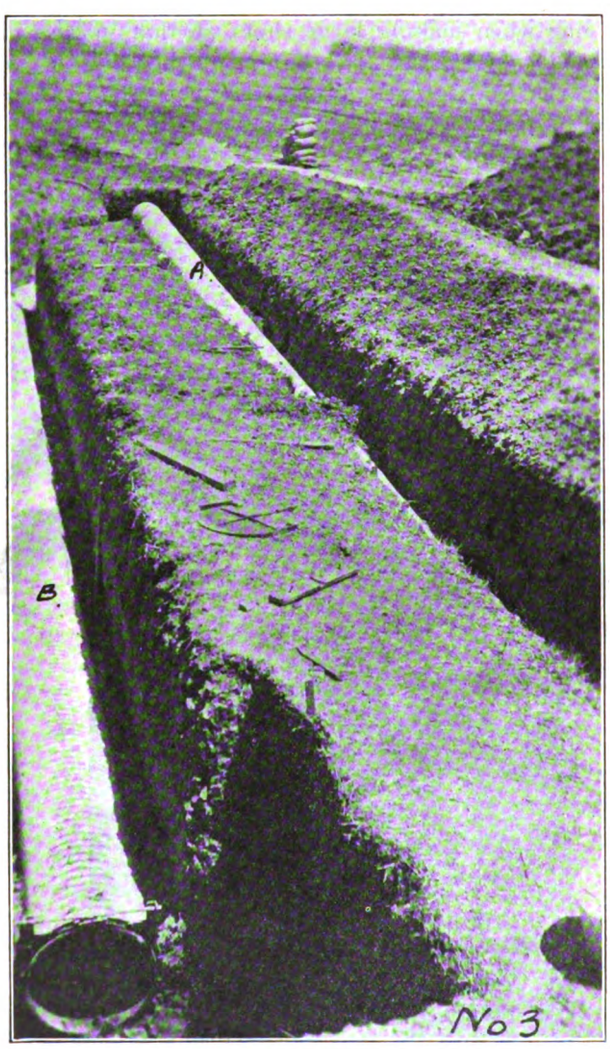
# Construction Features of Reclamation District 1001, Sacramento Valley, California

The development of the flood lands of the Sacramento valley has brought about several interesting methods for the protection of individual property-owners. This has been accomplished best by forming a reclamation district in which the improvements for the district are made as a whole and the cost distributed among the property-owners benefited. All plans for improvements must be first approved by the State Board of Reclamation. When its approval has been obtained, reclamation bonds or warrants are issued and sold as first mortgages on the land. When these funds are available, the actual development takes place.

Perhaps one of the largest sections which has been improved by this method is the project including approximately 37,000 acres in Reclamation District No. 1001, situated in the southern part of Sutter county, about 25 miles from Sacramento. This land is the ultimate watershed of seven streams which originate in the Sierra Nevada mountains some 60 miles away. In the height of the wet season, this land was formerly submerged. To alleviate this, a drainage canal has been built to control the run-off and carry the water into the Sacramento river. About 44% of this land is owned by the Natomas Consolidated, and the work is being carried forward under its supervision. Emery Oliver is chief engineer and general manager.




CORRUGATED INGOT IRON DRAINS.

The main levee, consisting of 500,000 cu. yd., and the side levees, containing 300,000 cu. yd., have been constructed. The grading contract amounted to approximately $250,000. The main canal varies in width from 350 to 470 ft. The earth fills have been obtained from excavating a ditch about 5 ft. deep and varying from 80 to 146 ft. wide. About one hundred and twenty Studebaker and Stroud dump-wagons received the dry earth from twelve Austin-Western elevating excavators and discharged it in the required positions. The open inclines in the levees where the wagons had been pulled to the crown, were filled after the proper height of bank had been built. Horses and mules were used for hauling, chiefly because the grading contractors had a large head of stock available. The stock and men were badly bothered at one time by black gnats, but little trouble was experienced in obtaining men, as work was scarce elsewhere.

The three salient features of the drainage problem were the siphoning of small drains from one side of the canal to the other, the placing of proper conduits to allow excessive run-off from the district itself to reach the drainage canal, and the method of handling the water to be regulated on either side of the canal for irrigation uses. Armco ingot iron corrugated pipe was used in conjunction with automatic flood-gates and by regulated pressure slide gates.

In handling the water from one side to the other, ingot iron corrugated pipe was also used and was built into concrete catch-basins on either end. In controlling excessive run-off water from outside the canal, automatic flood-gates of the type shown in the illustration were used, in conjunction with ingot iron corrugated pipe. Illustrations of the pipe immediately after being laid and after the concrete catch-basins were finished are shown herewith. The automatic flood-gate was so designed that the least variance in the head of the water outside the canal would open it, and when the water on the outside recedes to the same level as the water within the canal, the gates automatically close. In all cases the pipes were placed 12 in. above the bottom of the catch-basins, and as a further precaution against the entrance of débris iron gratings were placed over the top sides which were exposed.

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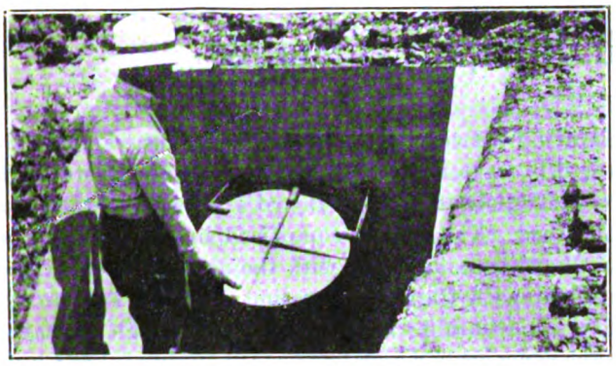


CHECK VALVES WHERE PIPES DISCHARGE INTO CATCH-BASINS.

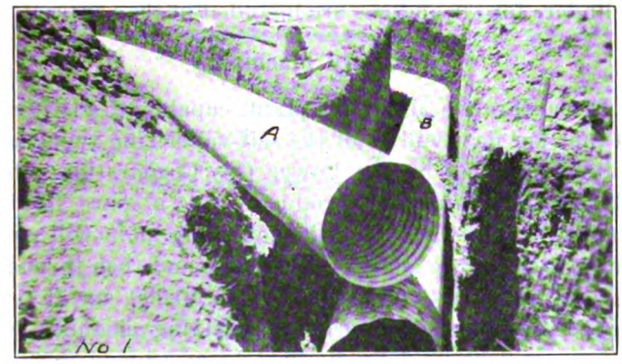
It was also the purpose of the concrete catch-basin to prevent the force of accumulating débris from raveling the earth fill. The pressure slide gates were used for the irrigation phase of the work, and these were placed wherever the individual farmers wished them. These gates can be closely regulated by means of a rod and wheel to furnish whatever water is desired in the irrigating season. In time of floods, they are kept tightly closed.

The magnitude of the project and the method of paying for the work was such that the engineers considered only permanent types of construction. These types were limited to concrete and corrugated pipe with proved rust-resisting qualities. The ingot iron corrugated pipe was finally decided upon for two reasons. It was easy and economical of transportation and has shown in years past, in numerous places, that it had unusually long life. It was further adaptable in conforming to faulty foundations without rupturing. The work required over 6000 lineal ft. of 24-in., 30-in., and 36-in. ingot iron corrugated pipe which was fabricated on the Pacific Coast.

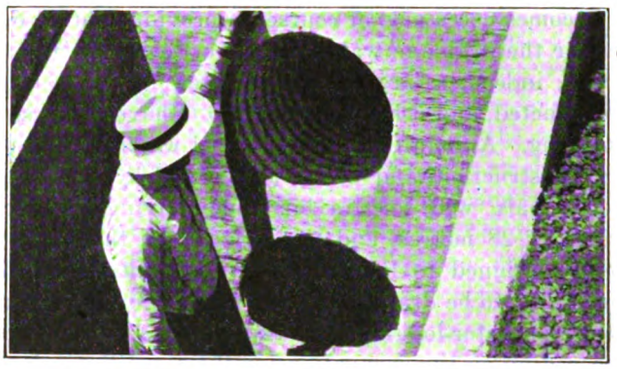
The pipe to be located under the fills was first installed, and the work carried on with a minimum of delay. The concrete catch-basins were all mixed in a 'Big-An-Little' concrete mixer in the proportion of 1:3:5. Yuba river sand, Natomas crushed rock, and Santa Cruz portland cement were used, the haul being an average of 5 miles.

The inverted siphon principle was used to avoid unnecessary excavation. With the corrugated pipe it would be safe to bend the pipe to a full curve, but it was possible to obtain the angles for fabricated siphons and to complete the line without difficulty in assembling and making tight joints, so the type of inverted siphon shown in the cross-section drawing was used in all cases. The lowest points on each siphon had one water-tight manhole, which was a T of 30-in. pipe. This was securely capped and about 6 in. of earth will ordinarily be over it. In the dry season, this manhole will permit the entrance of a laborer into the lowest level of the pipe to remove any accumulations which may have gathered. The raising of the ends of the siphons a foot above the bottom of the catch-basin and the placing of the iron grating above are planned to make the manhole serve more as an additional factor of safety.

The first survey of the district was ordered in 1909. Actual work was begun last May and is now finished except the timber work on a number of small bridges for the individual ranchers.




CORRUGATED INGOT IRON PIPES BEFORE COVERING.



TERMINATING CORRUGATED IRON SIPHON IN CONCRETE CATCH-BASIN.

John Tarish, the assistant engineer on the work, furnished the photographs and most of the accompanying information.

## CONCRETING RECORD AT ARROWROCK DAM

The June *Reclamation Record* gave what was believed to be a world's record for concrete placing with one-yard mixers, made at the Arrowrock dam, Boise project, in April 1914. The following figures show that the April record was substantially exceeded in every particular during May:

| | April. | May. |
|---|---|---|
| Total yardage for the month | 45,700 | 51,490 |
| Number of hours per shift | 8 | 8 |
| Number of shifts per day | 2 | 2 |
| Number of hours per day | 16 | 16 |
| Number of 1-yard mixers | 3 | 3 |
| Number of mixer hours per day | 48 | 48 |
| Number of working days | 26 | 26 |
| Number of mixer hours | 1,248 | 1,248 |
| Number of mixer hours delay | 165 | 68 |
| Number of mixer hours, delays deducted | 1,083 | 1,180 |
| Average yardage per day | 1,758 | 1,980 |
| Average yardage per 1-yd. mixer per day | 586 | 660 |
| Average yardage per 1-yd. mixer per hour, delays deducted | 42.2 | 43.9 |

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# Irrigation in Egypt With Humphrey Pumps

A contract has just been placed for the erection of a pumping station with Humphrey gas pumps at Mex, three miles west of Alexandria. The scheme, of which this station forms part, is a somewhat novel one, and some account of the work which is being undertaken by the Egyptian government will be of interest.

Up to the present time the Behira district, which is permeated by a network of canals, has been drained into Lake Mariut, which has an area of about 50,000 acres, but an average depth of only about 3 ft. The drainage of the hinterland, a large region about 60 by 40 miles, which is mainly under cotton, has had the effect of raising the level of the lake to the point at which it is no longer capable of draining this area, and for some time past these lands have tended to become water-logged. The scheme finally decided upon is to drain the lake and reclaim the area now under water. It becomes necessary, of course, to provide another outlet for the drainage water from the Behira district, in which, indeed, a large mileage of new canals is being constructed, and it has been decided to have recourse to pumping. A main discharge channel which is now under construction, and which will be fed by the irrigation canals, will form a big canal having a bottom width of 28 metres, and the capacity of this canal is being designed to lower the level of water over the large area to be drained to the necessary extent to prevent the water-logging. Work is at the present time proceeding on the excavation for the canal through the bed of the lake. This portion of the scheme is perhaps not very different from the ordinary drainage methods of the Government Department of Public Works, which is charged with the work, but the drainage of the lake and the type of plant to be installed in the pumping station presents several interesting features.

### The Pumping Plant

The first step in the sequence of operations now decided upon, on the advice and under the supervision of Harper Bros. & Co., who have been appointed consulting engineers to the Government of Egypt for this project, will be to pump the lake water into the sea, the lake being separated from the Mediterranean only by a narrow protecting ridge. This will be a comparatively simple task, and the main function of the pumping plant will be the permanent discharge of water from the big canal. The lift to be provided for is from 19 to 20 ft., and the first section of the plant, which will be duplicated at a later date, will consist of ten Humphrey pumps, two of which will be spares. Five of the pumps are being supplied by Beardmore and five by Brown Boveri. The eight pumps in service will have a total capacity of 792,000,000 gal. of water per 24 hours. The great size of the pumps may be judged from the fact that each unit is to be capable of delivering between two and three times the amount delivered by each large Humphrey pump unit installed at the Metropolitan Water Board's pumping station at Chingford. The pumps comprised in the present contract have been designed with the aid of the experience obtained with Chingford station, and are said to embody some notable improvements, although operating on the same cycle which has proved successful at Chingford. The maximum internal diameter of the combustion chamber will be 8 ft. 8 in. and its height about 14 ft. The water valve box will be 8 ft. 8 in. diameter and 7 ft. high, and will be fitted with 100 valves of the hinge type designed to enable any valve to close upon an obstruction, such as a piece of wood, without throwing undue strain on the hinges. The design is such that on the next stroke, when the obstruction has been removed by the rush of water, the valve will automatically readjust its position and close fairly upon its seat. This type of valve is a result of careful experiment, and has proved itself satisfactory under test.

All the main steel castings will be carried upon a steel bend which connects to the play-pipe. This bend will be in two parts, making up the 118.5° required to connect with the inclined play-pipe. At Chingford the bend had an angle of 90° and connected to a horizontal play-pipe, which in turn connected through a second 90° bend to a vertical conical water tower. At Mex, however, there will be only one bend, and the play-pipe will be sloped upward so as to deliver the water at the required elevation in the discharge basin. In order to reduce the velocity of the water at the exit the play-pipe will terminate in a long conical portion giving an outlet 12 ft. in diametre. Not only does a sloping play-pipe eliminate one of the bends and permit simpler construction, but it has the additional advantage that the vertical components of the forces due to the momentum of the moving masses of water in the combustion chamber portion and play-pipe portion respectively are balanced. The pumps will be started by admitting into the combustion chamber a mixture of gas and air, and compressors capable of rapidly charging the pumps for this purpose and having separate cylinders for air and gas are included in the contract.

### Auxiliary Machinery

The anthracite Mond gas plant, capable of gasifying 44 tons per day, will be of the self-vaporizing type, and will be supplied by the Power Gas Corporation, Ltd. There will be nine 6-ft. producers, one a spare, of the luted type. The gas from the collecting main will pass through two large gas cooling towers, and then through dry scrubbers into a gas-holder of 10,000 cu. ft. capacity, which besides forming a mixing chamber for the gas will be used for accurately measuring the gas during the official trials of the plant, the plant being

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supplied under a guaranteed consumption of 1.15 lb. of coal per water horse-power.

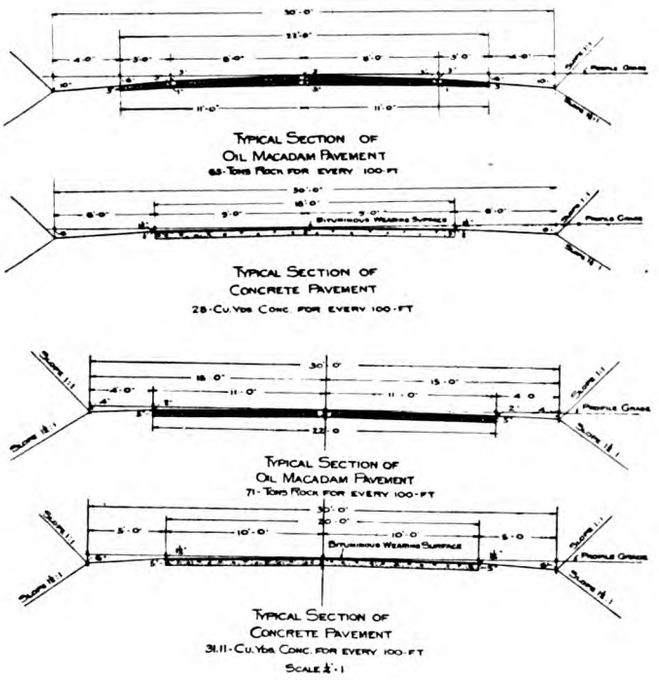
A plant for electric power and lighting included in the contract will comprise two gas engines, each for 180 b.hp. normal load, of the two-cylinder horizontal type, running at 190 r.p.m. and direct coupled to 120-kw. generators. The current will be supplied at 220 to 230 volts, and the plant will be complete with generator, power, and distribution switchboard panels. The lighting will be partly by arc and partly by incandescent lamps, and the capacity of the plant is such that one unit will normally run the whole of the electrically driven auxiliaries both at the producer plant and at the main pump house. As this plant has to start operation in order to furnish current to the large overhead traveling crane, and for working the centrifugal drainage pumps during excavation, it will be supplied with a 200-hp. suction gas producer plant for temporary use until the main plant is at work.

A Pooley railway weighbridge will be placed at the entrance to the sidings for the main installation, and a 30-ton electric crane in the pump house, to be supplied by Jos. Booth & Bros., Ltd., will have separate motors for the two lifting speeds and for longitudinal and transverse motions.—*Times Engineering Supplement.*

# Engineer's Note Book

## TYPICAL SECTIONS OF CONCRETE PAVEMENT

The following typical sections of concrete pavement have been published through the courtesy of the Los




Angeles County Highway Commission and are standards that have been adopted for use throughout the county.

## COST OF CONCRETE AND STAVE SILOS

Recent data on the cost of home-made silos collected by the Dairy Division of the U. S. Department of Agriculture from all parts of the country show the following relative cost of the concrete and stave type:

| Type of silo. | No. of silos. | Av. capacity, tons. | Av. cost. | Av. cost per ton capacity. |
|---|---|---|---|---|
| Concrete: | | | | |
| 100 tons or less..... | 71 | 71 | $220.47 | $3.10 |
| 101 to 200 tons..... | 50 | 135 | 348.68 | 2.59 |
| More than 200 tons..... | 23 | 219 | 446.42 | 2.04 |
| Total concrete ..... | 144 | 117 | $301.08 | $2.58 |
| Stave: | | | | |
| 100 tons or less..... | 25 | 63 | $118.40 | $1.87 |
| Over 100 tons ..... | 16 | 129 | 187.46 | 1.45 |
| Total stave ..... | 41 | 89 | $145.35 | $1.63 |

**Diameter Based on Size of Herd.**—The following table will show the proper diameter of the silo for herds of different sizes to be fed different amounts for winter feeding, when 2 in. of silage is removed daily:

Relation of size of herd to diameter of silo for winter feeding (on basis of 40 lb. of silage per cubic foot).

| Inside diameter of silo, ft. | Quantity of silage in depth of 2 in., lb. | No. of animals that may be fed allowing | | | |
|---|---|---|---|---|---|
| | | 40 lb. per head. | 30 lb. per head. | 20 lb. per head. | 15 lb. per head. |
| 10 | 524 | 13 | 17 | 26 | 35 |
| 11 | 634 | 16 | 21 | 31 | 42 |
| 12 | 754 | 19 | 25 | 37 | 50 |
| 13 | 885 | 22 | 29 | 44 | 59 |
| 14 | 1026 | 25 | 34 | 51 | 68 |
| 15 | 1178 | 29 | 39 | 59 | 78 |
| 16 | 1340 | 33 | 44 | 67 | 89 |
| 17 | 1513 | 38 | 50 | 75 | 101 |
| 18 | 1696 | 42 | 56 | 85 | 113 |
| 20 | 2094 | 52 | 70 | 104 | 139 |

A 900-lb. cow will ordinarily consume 30 lb. of silage per day; a 1200-lb. cow about 40 lb. Yearlings will eat about one-half as much as mature animals; fattening cattle, 25 to 35 lb. for each 1000 lb. live weight. A sheep will take about one-eighth as much as a cow. Horses should be limited to 15 to 20 lb. daily.

**Depth of Silo.**—In general, the depth of the silo should not be less than twice nor more than three times the diameter. The greater the depth the better the silage, on account of the pressure from above. If less than 24 ft. in height, the quality of silage will not be

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the best. A very great height, however, is to be avoided on account of the excessive amount of power required to elevate the cut corn into the silo.

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We are indebted to the Busch-Sulzer Bros.-Diesel Engine Co., Rialto building, San Francisco, for the following performance data taken from the 900-hp. Diesel engine installation at the power plant of the Anheuser Busch brewery at St. Louis, Missouri:

**PERFORMANCE OF DIESEL ENGINE POWER PLANT**

FOR MONTH December 1913.

**ENGINE A. (WEST SINGLE)**

| PRODUCTION | | FUEL OIL CONSUMED | |
|---|---|---|---|
| METER READING Jan. 1-1914 | 109460 K. W. HRS. | METER READING Jan. 1-1914 | 71451 GALLONS |
| " " Dec. 1-1913 | 83620 " | " " Dec. 1-1913 | 69067 " |
| PRODUCED (GROSS) | 25840 K. W. HRS. | OIL CONSUMED (GROSS) | 2384 GALLONS |
| NUMBER HOURS RUN | 231 hrs. 15 min. | LESS RETURNED TO TANK | 16½ " |
| | | OIL CONSUMED (NET) | 2367½ GALLONS |
| GALLONS OF FUEL OIL (NET) PER 100 K. W. HOURS (GROSS) AT SWITCH BOARD | | | 9.16 |

**ENGINE B. (EAST SINGLE)**

| PRODUCTION | | FUEL OIL CONSUMED | |
|---|---|---|---|
| METER READING Jan. 1-1914 | 86030 K. W. HRS. | METER READING Jan. 1-1914 | 69653 GALLONS |
| " " Dec. 1-1913 | 60680 " | " " Dec. 1-1913 | 67393 " |
| PRODUCED (GROSS) | 25350 K. W. HRS. | OIL CONSUMED (GROSS) | 2260 GALLONS |
| NUMBER HOURS RUN | 227 hrs. 15 min. | LESS RETURNED TO TANK | 11 " |
| | | OIL CONSUMED (NET) | 2249 GALLONS |
| GALLONS OF FUEL OIL (NET) PER 100 K. W. HOURS (GROSS) AT SWITCH BOARD | | | 8.87 |

**ENGINE C. (DOUBLE UNIT)**

| PRODUCTION | | FUEL OIL CONSUMED | |
|---|---|---|---|
| METER READING Jan. 1-1914 | 377495 K. W. HRS. | METER READING Jan. 1-1914 | 17578 GALLONS |
| " " Dec. 1-1913 | 296800 " | " " Dec. 1-1913 | 10680 " |
| PRODUCED (GROSS) | 80695 K. W. HRS. | OIL CONSUMED (GROSS) | 6898 GALLONS |
| NUMBER HOURS RUN | 260 hrs. | LESS RETURNED TO TANK | 22 " |
| | | OIL CONSUMED (NET) | 6876 GALLONS |
| GALLONS OF FUEL OIL (NET) PER 100 K. W. HRS. (GROSS) AT SWITCH BOARD | | | 8.52 |

**POWER USED BY AIR COMPRESSORS**

| | | | |
|---|---|---|---|
| COMPRESSOR A. (SOUTH) | METER READINGS Jan. 1-1914 | 12997 K. W. HRS. | |
| | " " Dec. 1-1913 | 9443 " | |
| | USED BY COMPRESSOR A. | | 3554 K. W. HRS. |
| COMPRESSOR B. (CENTER) | METER READINGS Jan. 1-1914 | 48890 K. W. HRS. | |
| | " " Dec. 1-1913 | 40620 " | |
| | USED BY COMPRESSOR B. | | 8270 K. W. HRS. |
| COMPRESSOR C. (NORTH) | METER READINGS Jan. 1-1914 | 4786 K. W. HRS. | |
| | " " Dec. 1-1913 | 2792 " | |
| | USED BY COMPRESSOR C. | | 1994 K. W. HRS. |
| TOTAL POWER USED BY COMPRESSORS | | | 13818 K. W. HRS. |

Total Power Generated 131885 K. W. Hrs.
Less Power Used By Compressors 13818 "
Net Power Generated 118067 K. W. Hrs.

**SUMMARY**

NET POWER GENERATED DURING Dec. 1913 — 118067 K. W. HRS.
FUEL OIL CONSUMED DURING Dec. 1913 — 11492½ GALLONS
COST OF ABOVE FUEL OIL AT 2.93 CENTS PER GALLON = 336.73
GALLONS OF FUEL OIL PER 100 K. W. HRS. NET AT SWITCH BOARD 9.73 GALLONS
COST OF FUEL OIL PER NET K. W. HOUR " " " = 0.00285

The following figures were compiled from the operating engineer's monthly performance report above:

| | | |
|---|---|---|
| Hours plant was operated | 240 | |
| Total net output | 118,067 kw.-hours | |
| | | Cents per kw.-hr. |
| Fuel oil, 11,492½ gal. at 2.93c | $336.73 | = 0.2850 |
| Lubricating oil, 103½ gal. at 30c | 31.05 | = 0.0263 |
| Water | 45.85 | = 0.0388 |
| Supplies (averaged) | 5.00 | = 0.0043 |
| Labor | 325.16 | = 0.2750 |
| Maintenance and repairs (averaged) | 25.00 | = 0.0212 |
| Total | $768.79 | 0.6506 |

This 900 brake horse-power installation operates in parallel with the brewery's central station plant. It operates ten hours per day with a 77% load factor. Two single units are direct connected to 160-kw., 250-volt, D.C. generators, the twin unit of 450 b.-hp. to one generator of 320 kw. In common with other Diesel operators, the engineer of this plant requires less than three minutes to start his engines and have same under full load. When shut down, he turns the key in the lock and goes home—there is absolutely no stand-by expense connected with the operation of a Diesel plant.

The total operating expenses of an equivalent steam plant with coal at $1.75 per ton: Non-condensing, 1.24c. to 1.34c. per kw.-hr.; condensing, 1.04c. to 1.1c. per kw.-hr.

# Book Reviews

FOUNDATIONS. By Malverd A. Howe. P. 103. Index. John Wiley & Sons, New York. For sale by *Mining and Scientific Press*, San Francisco. Price, $1.25.

This is a textbook written with the object in view of presenting in an elementary manner the fundamental principles upon which the proper design of foundations is based. The subject matter has been prepared under the following subdivisions: Supporting Capacity of Soils; Wall Footings and Column Footings; Piles and Pile Foundations; Chimneys and Towers; Bridge Piers and Abutments; Methods Employed for Difficult Foundations; and an Appendix.

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OIL FUEL. By Edward Butler. P. 318. Index. J. B. Lippincott Company, Philadelphia. For sale by *Mining and Scientific Press*, San Francisco. Price, $2.25.

This is the third edition of Mr. Butler's work, and presents a systematically classified record of the developments and progress made in the application of oil fuel for steam generation, metallurgical, and other purposes other than for internal combustion engines and for which oil may be usefully employed. The chapters on the various forms of burners are exceptionally good, and the book as a whole is decidedly worth while, especially with respect to the combustion of oil in industrial applications.

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THE STORAGE OF PETROLEUM SPIRIT AND CALCIUM CARBIDE. By Major A. Cooper-Key, C.B. P. 128. Index. J. B. Lippincott Co., Philadelphia. For sale by *Mining and Scientific Press*, San Francisco. Price, $1.

The subject under discussion is treated from a British standpoint and deals mainly with suggestions as to the best methods of administering the laws of Great Britain with reference to the handling of petroleum spirit. Its value to American readers consists chiefly of the information imparted as to the method of attacking the problem abroad, a knowledge of which being of great assistance in meeting similar problems in the United States.

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PRACTICAL CALCULATIONS FOR ENGINEERS. By C. E. Larard and H. A. Golding. P. 380. Index. J. B. Lippincott Company, Philadelphia. For sale by *Mining and Scientific Press*, San Francisco. Price, $2.

Ordinarily engineering calculations are to be found only in works dealing with the subject to which the calculations apply. In this case, a compilation has been made of the calculations used for all sorts of engineering work, with this important difference from the ordinary engineering handbook, namely, that explanations and typical examples are given showing how the calculations are made. This is the third edition of this work, the first having appeared in 1907. It is especially valuable to students and others who are apt to find memory rather treacherous when the necessity arises to recall formulæ and methods of calculation that have been infrequently used.

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METHODS OF MACHINE SHOP WORK. By Frederick A. Halsey. P. 279. Index. McGraw-Hill Book Co., New York. For sale by *Mining and Scientific Press*, San Francisco. Price, $2.50.

This is one of the too few exemplifications of the true functions of a technical work, that is, the compilation and presentation in systematic form of the many ingenious methods, shop 'kinks,' in other words, that have been developed by individuals and are unknown outside of the sphere of their own personal acquaintance and shop associates.

An old machine shop man, in perusing the pages of this work, will undoubtedly encounter ideas and methods with which he is already familiar. At the same time, he will learn of those with which he is not familiar. As a former machine

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man, the reviewer was struck with the latter, and is willing to hazard the opinion that the majority of those interested in the subject will have the same experience. There are many skilled mechanics in the United States, in fact with some of them whom we have known, their skill really amounts to genius. It is men of this stamp who will most keenly appreciate the real value of this work.

The subdivisions under which the subject has been treated include: The Two Systems of Machine Producing; Precision Work and Workmanship; Measures of Length; The Measurement of Errors; Gauges; Fits and Limits; Driving Systems for Machine Tools; Turning and Boring; Floor Plate Work; Drilling; Milling; Gear Cutting; and Grinding.

# Hints on Practice

## REPAIRING BUILDING SUPPORTS AND FOUNDATIONS WITH CONCRETE.

A common source of annoyance and expense is the decay or giving way of building supports and foundations. When this occurs it is considerable trouble to replace these with new timber or ordinary masonry. It frequently happens that a building is in first-class condition while its supports have disintegrated or collapsed. For making repairs of this character, concrete surpasses any other material. This is due to the fact that it is a plastic substance and may be molded or poured into recesses not readily accessible when another material is used. Timber supports may be renewed without jacking up the building beyond its original elevation.

For example, let it be assumed that a building is resting upon wooden or timber supports which have decayed at the

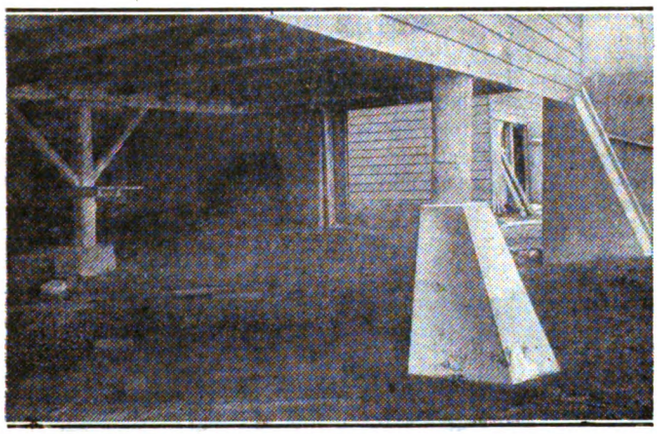

FIG. 1.

ground level, which always occurs when timber is subjected to alternate wetting and drying. It is an exceedingly simple matter to remedy a situation of this kind with concrete. One has merely to support the building with temporary struts, which should be placed near the post to be removed. The old post should then be sawed off entirely above the rotten part, the suspended part consisting of sound timber. Directly under this suspended post, dig a hole 2 ft. deep and slightly larger than the post itself. Fill the hole with a mixture of concrete consisting of 1 part portland cement, 2 parts sand, and 4 parts stone. On top of this place a box with open ends, its inside measurement conforming to the dimensions of the hole. This box should be made and ready to use before any concrete is mixed or placed. Its length should be sufficient to reach from the ground to a few inches above the bottom of the sawed support. When in position, fill it with concrete until the bottom of the sawed-off post is imbedded about ½ inch in the concrete. Proceed as above with each support, leaving the boxes or forms in place for one week, and after two weeks the struts used as a temporary support for the building may be removed. The concrete should be mixed thoroughly wet and tamped or puddled with a stick while being placed.

In the case of large buildings elevated quite a distance above the ground, the new support or foundation may be made larger at the bottom than at the top by sloping one side of the box form, as shown in Fig. 1.

### TO REPLACE A CONTINUOUS FOUNDATION WITH CONCRETE

This can be done by the owner with the help of ordinary labor, even where buildings are quite large and the foundation is of the continuous type, requiring jacking up of the structure. At necessary points remove a few heavy stones or bricks, as the case may be, and insert short pieces of heavy timber to wedge up the building. The building should be carefully raised by this means until entirely free from all foundation. Then remove all of the old foundation and set in place the forms for the concrete. In the case of small buildings it is usually feasible to raise them high enough to allow working room, in which case the form may be filled right up

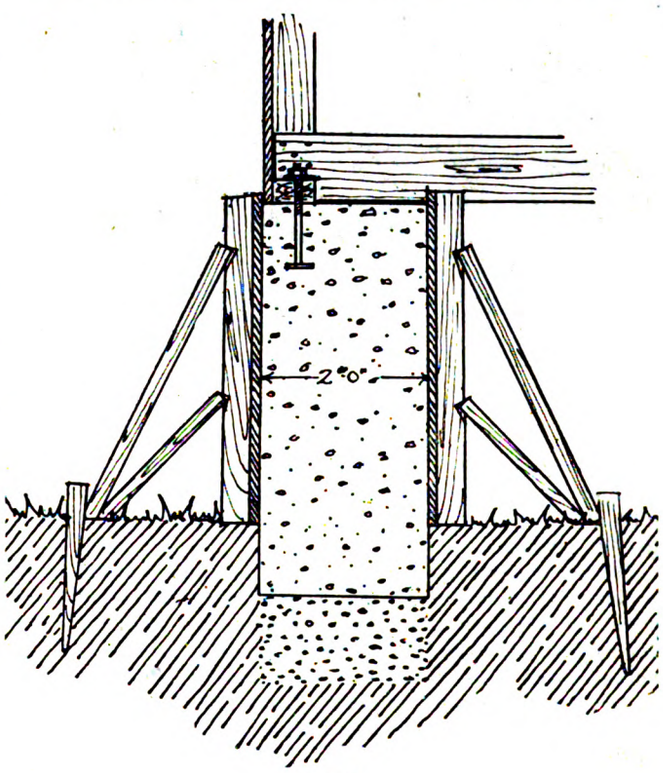

FIG. 2.

to the top with concrete. The concrete should be a wet mixture consisting of 1 part portland cement, 2 parts sand, and 4 parts stone.

Should the building be too large and heavy to be raised to a height that will give head room, merely make the foundations 3 in. wider than the sill. Then when the forms are carried to the desired height the concrete may be inserted through this extra space of 3 in. To facilitate the placing of the first layers of concrete, the top board of the forms may be left off until ready to place the last of the concrete. This last batch should be very wet. The concrete should be tamped until it comes up flush to the bottom of the sill and to the entire width of the wall.

Make certain that a space is left in the concrete wall under and on the sides of the underpinning support so that the building may be lowered onto the new foundation and the

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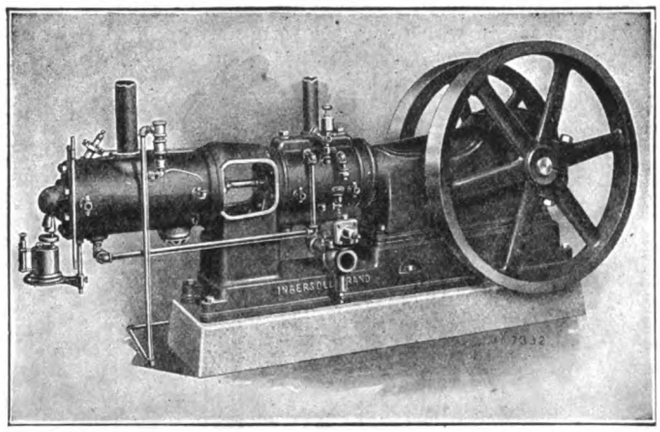
timber removed. This opening, of course, must be slightly larger than the underpinning support. The building should not be lowered until the foundation has been in place two weeks, and after this is done the openings occupied by the underpinning may be filled with concrete. Fig. 2 shows how the forms should be constructed.

# Industrial Progress

## AN OIL ENGINE DRIVEN AIR-COMPRESSOR

It may be said that there is no mode of power generation and application which is not available for the driving of some type of air-compressor built by the Ingersoll-Rand Company. The machine here illustrated, which may be said to complete the series of compressors so far as the driving is concerned, as it is designed to be driven not by gasoline, which is now becoming so costly, but by the cheaper kerosene, fuel oil, or distillate, may claim the unique distinction of being operated at a lower cost per volume of air compressed than any other type of compressor in existence for which the power is artificially developed.




OIL ENGINE DRIVEN INGERSOLL-RAND AIR-COMPRESSOR.

The air compressing portion of this machine is of the latest standard Ingersoll-Rand type designated as NE or NF, the details of which need not here be enumerated. The air cylinder as here shown is 7 in. diameter and 8-in. stroke, and at a normal speed of 325 r.p.m. will compress and deliver 66 cu. ft. of free air per minute at 100-lb. gauge pressure or 73 cu. ft. at 80 lb., full allowance being made for clearance and re-expansion.

At the rear of the air cylinder a distance-piece is attached for carrying the oil engine cylinder, the air piston rod being continued into the latter. This piece serves as a standard for the end of the machine and gives a long sub-base bearing. The oil engine cylinder is completely isolated from the air cylinder, so that the air is not heated when running, and with this construction the machine may be easily taken apart and re-assembled without the possibility of getting anything out of line.

The general operating design is of the 'hot bulb' type, a close relation of the Diesel engine without the complication of the highly compressed air injection. A torch is provided for heating the ignition bulb preparatory to starting the engine, but after the compressor is under way the heating is self-maintained. The fuel is automatically injected into the combustion chamber by means of a small pump operated by the main shaft. It enters in the form of a finely atomized spray and is immediately ignited by the hot bulb. The stroke of the fuel pump is regulated by a centrifugal governor in the flywheel, and this determines the amount of fuel injected into the cylinder, making it proportional to the load. This method of regulation is also supplemented by a regulating device on the intake of the air cylinder.

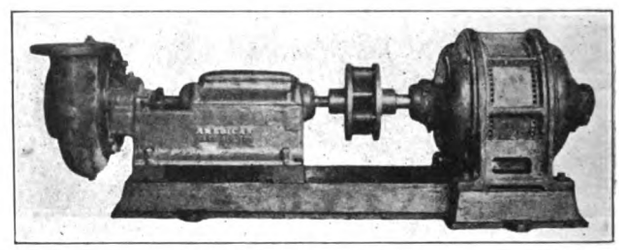
The method of operating this unit is accompanied by none of the losses common to many two-cycle gasoline engines, in which part of the incoming charge follows the exhaust gases through the outlet ports. This is due to the fact that the fuel is not vaporized by an outside agency and introduced with the air used for 'scavenging;' but is injected directly into the cylinder at the end of the compression stroke. This means that pure air is used during the scavenging period of the stroke, with the result that the inlet and outlet ports can be arranged in such a way that more thorough scavenging is effected without any loss of fuel. The absence of a carbureter with its needle valves, springs, and delicate adjustments, which require constant attention to suit varying atmospheric conditions is also a material advantage.

Another feature of the engine is the provision of means for inducting a small quantity of water from the cylinder jacket into the combustion chamber. This water performs the function of regulating the temperature in the cylinder, thereby preventing an undue rise in the temperature of the piston and cylinder walls, which would be liable to result in a disassociation of the fuel oil. This practice reduces the maximum pressure in the cylinder, but slightly increases the mean effective pressure, making a smooth running and highly economical engine. The amount of water injected is regulated according to the load on the compressor.

The compressor as here shown occupies a floor space of 8 ft. 10 in. by 2 ft. 5 in. and weighs 3000 lb. Under average operating conditions, and with the normal air output the fuel consumed is about 2.2 gal. of kerosene per hour.

## HIGH-SPEED CENTRIFUGAL PUMP FOR DIRECT MOTOR DRIVE

The type 'P' centrifugal pump is manufactured by the American Well Works of Aurora, Illinois. It has been designed especially for high speed motor service, and is so arranged that it is not necessary to have a continuous base between the pump and motor.



HIGH-SPEED CENTRIFUGAL PUMP FOR DIRECT MOTOR DRIVE.

The pump and motor can be lined on a separate concrete foundation, or they can be placed on timbers or I-beams, and the pump bearings, which are of the double-ring oiling type, are entirely separate from the stuffing-box and cannot get out of line. In this type of pump, no outboard bearing is used. There is no bearing in the volute chamber and it is impossible for sand to get to the bearings. The shaft of the pump is very large and all bearings run in an oil reservoir which has a hinged top so that at all times the bearings run in an oil bath.

It is believed that the use of this pump will eliminate entirely the trouble which has been had previously with centrifugal pumps direct connected to motors. The pump has an unusually long foot and has a ball thrust collar with adjusting nut.

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# Construction News Summary

**Condensed From Our Daily Construction News Service.**

## ALASKA

**JUNEAU**—Speel River Electric Chemical Co. and Speel River Power Co., which have obtained a government grant for hydro-electric chemical and power plant on Speel river, 35 miles south, expect to start construction within a few months. E. P. Kennedy, Hotel Washington, Seattle, is interested.

## CALIFORNIA

**ALAMEDA**—The special street committee will recommend to the City Council the installation of an asphalt plant in Alameda and the placing of 1½ or 2-in. asphaltic concrete wearing surface over the new streets to be built. James Sutton is city engineer.

**AUBURN**—By reason of technical irregularities in the issue 250 for street improvement and for a new water system have both been approved by the voters. Of this amount, $150,000 is to be expended for new streets and $131,250 for building the water system.

**AUBURN**—By reason of technical irregularities in the issue of school bonds of Auburn and Roseville, amounting to $47,000 and $45,000, respectively, sale of bonds has been declared off and new election will have to be called.

**BAKERSFIELD**—Contract has been awarded to Trewhitt & Shields for the construction of the Kern County high school auditorium. Price $53,920.——Contract has been let to the American Heating Co. for the construction of the heating plant. Price $21,990.——Weitzer & Larsen have been awarded cement sidewalk contract on Baker street by Board of Trustees. Bid was $3453.58.

**BLAIRSDEN**—The Inter-State company has finished grading for its new $140,100 log cabin tavern. Building operations will be started soon, as bids are now called.

**CALEXICO**—The city engineer has been instructed to prepare plans for constructing a pipe-line or enclosed conduit from central main canal to city reservoir. Estimated cost, $25,000.

**CALISTOGA**—Plans are being prepared by W. H. Castner, of Healdsburg, for a new sewer system.

**CLOVIS**—The following bids have been received for the construction of the Carnegie Free Library: W. H. Minard, $6675; W. D. Stephenson, $7855; Ackerman & Heisel, $8121; L. C. Matthews, $8227. The contract has been awarded to W. H. Minard.

**DINUBA**—W. P. Boone has resigned as a director of the Alta Irrigation district. Abner Frazier will probably succeed him. ——Vernon A. Campbell, manager of the Co-operative Cannery at Porterville, is preparing plans for the construction of a cannery at this city.——Harry McCray, civil engineer of Bakersfield, has been appointed as county surveyor to fill the unexpired term of M. W. Buffington, deceased.——Board of Trustees votes to install a fire-alarm system to be connected to local plant of Pacific Telephone & Telegraph Co.——The County Supervisors have decided to construct a public highway from Riverbank to Burneyville.

**EAGLE ROCK**—Bids will be received until 8 p.m., October 8, by City School District, for constructing 5200 sq. ft. of macadam, 260 lin. ft. of curb, and 1300 sq. ft. of sidewalk in Linden way. Plans may be obtained from R. L. McNutt, city clerk.

**FAIR OAKS**—Stephen E. Kiefer, engineer for the proposed Fair Oaks irrigation district, has commenced examination and preliminary work.

**FALL RIVER MILLS**—A petition has been filed with the supervisors asking for the formation of the Fall River Valley West Side Irrigation District.

**FRESNO**—The Fresno Interurban Railroad, which now has a line extending from Belmont and Fresno avenues to Albina Heights, is planning an extension 1¼ miles in length to a point near the Normal School. J. B. Rogers has applied to the city supervisors for a franchise.——Resolution of intention No. 996, calling for the improvement of a number of city streets, has been passed by the City Council.——Ernest J. Kulp has announced that plans and specifications are ready for the new schoolhouse that is to be built on Kearney Boulevard heights.——Bids have been called by the city of Fresno school district for the construction of a 13-room school building. Plans and specifications have been prepared by Coates & Traber, architects, room 626 Rowell building, Fresno. Bids will be opened on October 23.——It is proposed to install cement sidewalks in the city court-house park. Estimated cost, $6500.—— Plans and specifications are being prepared by the city engineer for a city electrolier system.——Fresno Traction Co., F. W. Webster, manager, will begin double-tracking Fresno, Sylvania, and Belmont avenues. Cost will be about $50,000. Paving of tracks on J street is contemplated.——The County Supervisors have appointed G. A. Parker and J. W. Wright to make a survey for a 4-mile cut-off road to connect with the Sand Creek road.——Sub-station of the Northern California Power Co. was destroyed on August 28 by fire.——Plans for the George Helm residence have been completed by Richard Kump, architect. Estimated cost, $18,000. Separate water and light plants are to be installed.——Architect Mathewson has completed plans for new Washington school to be erected at Dearborn and Glenn avenues. Estimated cost, $95,000. Building will be of brick and two story.

**GAVIOTA**—Charles Janin, of this city, is in the market for a 10 to 15-hp. gasoline engine, mounted on a truck; a 4-in. centrifugal pump; and 1500 ft. of 6-in. diameter pipe.

**GRASS VALLEY**—Thomas E. Horan awarded contract for constructing concrete conduit underneath the Stockton hotel. ——A contract has been awarded by the City Trustees to T. E. Horan for $460 for excavating, laying pipe, refilling, connecting, and constructing manholes for the city sewer. Price also $5 per cubic yard for excavating to solid bedrock. A new concrete crossing is to be constructed across Colfax Ave. on east side of Auburn St.——The Board of School Trustees is considering the advisability of a bond issue to provide funds for the construction of a new high school.

**HEALDSBURG**—The Associated Raisin Co. has let contract to Johnson Bros. to extend its reinforced concrete warehouse; extension will be 80 by 80 ft. Old Phoenix packing-house will have to be demolished.

**HOLLISTER**—Board of Supervisors has accepted plans of County Surveyor Hare, of Monterey county, for the construction of five county bridges at Aromas. Depleted condition of road funds makes payment impossible if contract is awarded prior to December 15.

**HOLLYWOOD**—The Fifth Church of Christ, Scientist, will erect a new church at the corner of Hollywood boulevard and La Brea Ave. Frank L. Meline, of Hollywood, is architect.

**HUGHSON**—Plans and specifications for the entire remodeling of the Hughson high school are under consideration by the Board of School Trustees.

**KESWICK**—County bridge across Sacramento river was destroyed by fire on August 27. Original cost of bridge, $9000.

**LINDSAY**—Contract has been awarded to Ely Graham for erection of a new packing-house for Randolph Fruit Co. Price $22,000.——Mt. Whitney Electric & Power Co. has offered to donate the electroliers for 23 blocks; conduits are now being laid coincident with paving work.

**LONG BEACH**—It is reported that Craig Shipbuilding Co. has closed contract for construction of steel-hull dredge, capacity 20,000 cu. yd. per day. It will cost approximately $270,000. ——City Council has called an election for September 30 to vote bonds for purchase of site and construction of a Municipal Auditorium. Project will involve expenditure of more than $1,000,000.

**LORDSBURG**—The directors of the La Verne Orange Growers Association have been authorized to expend $50,000 for the erection and equipment of a pre-cooling plant. Capacity 20 tons of ice per day.

**LOS ANGELES**—The Harbor Commission has awarded a contract to the Pacific Fire Extinguisher Co. for placing a sprinkling system in Shed No. 2, Pier A. Price $5466.86.——Board of Public Works has asked the City Council for permission to award contract to R. H. McCarey, Jr., for the improvement of a section of Western Ave. Price $1250.——The following bids have been received by the Board of Supervisors for the construction of 2½ miles of roadway on the Santa Monica road from the city limits through Sherman: George S. Benson & Sons, $12,594.12; R. S. Matthews, $13,307.71; C. H. Hudson, $13,339.48; Brashear, Burns Co., $14,835.21; Roadway Construction Co., $15,538.30.——Eastern architects have forwarded plans for a reinforced concrete and steel construction church, 225 by 100 ft., to seat 1750. Bids will be called soon. Rev. Joseph S. Glass, pastor St. Vincent's Church, will be in charge until the arrival of architects from the East.——An 11-story hotel, 50 by 150 ft., steel frame faced with terra cotta, at a cost of approximately $225,000, will be built for H. O. Thompson; J. J. Frauenfelder, architect.——The Public Works Committee of the City Council will recommend that the Board of Public Works execute a contract with P. J. Shea for the construction of the Madison Virgil storm drain. Price $237,000.——The Board of Public Works has awarded a contract to B. Wucetich for the construction of the sanitary sewers in the Vignes-street district. Price $17,364.——The Board of Public Works will

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order the placing of ornamental lighting posts on Harvard and Wilshire boulevards and on Mariposa street. The city electrician states that an offer has been made to furnish posts for $32 each.——The City Council has approved the assessment for the lowering of the grade of the Broadway tunnel. Fred Atkinson is contractor. Amount $194,240.——The Board of Public Works will re-advertise for bids to be opened on October 5 for the construction of the Brent street, Wilmington, sewer. ——Col. Louis Ginger has applied to the Park Commission for a franchise for an incline railway in Griffith park.——The City Council has authorized the Board of Works to proceed with protective work on the banks of the Arroyo Seco.——At the request of property-owners, the contract has been let to the Fairchild-Gilmore-Wilton Co. for the improvement of the section of 6th street, San Pedro. Price $11,457.——The City Engineer is preparing plans for the improvement of a section of 5th street. The City Engineer has presented ordinances of intention for paving curbs, sidewalks, gutters, and lighting conduits on a section of Fremont avenue, a section of Alameda street, a section of Brighton avenue, and a section of 3rd street. New sewers are also to be installed.——Fairchild-Gilmore-Wilton Co. awarded contract at $114,025.50 for improving 6th street between Palos Verdes and Cabrillo streets. Work consists of 3990 lin. ft. of grading, 148,239.9 sq. ft. asphalt paving, 22,145.90 sq. ft. asphaltic concrete paving, 154.50 sq. ft. asphalt repaving, 82,859.26 sq. yd. cultivate, tamp and oil; 8477.68 lin. ft. cement curb; 49,195.60 sq. ft. cement sidewalks; 380 sq. ft. concrete gutter; 346.86 sq. ft. granite block gutter; $16,000 for storm drain; $17,000 for sanitary sewer; $1000 for ornamental lighting system; $230 remodeled catch-basin; $175 new catch-basin; $125 vitrified pipe culverts.——Fairchild-Gilmore-Wilton Co. awarded contract in $97,120.36 for improving Lyon street between Macy and Aliso, consisting of 457,000 sq. ft. asphalt paving and grading, 2912 sq. ft. vitrified brick paving and grading, 5612 lin. ft. cement curb, 71,280 sq. ft. cement sidewalks, 396 sq. ft. granite block gutter, $1650 for storm drain and appurtenances. Other bids: Ford & Stout, $113,887.60; George R. Curtis, $110,395.20.——Hoover street, from Bernard avenue to 51st street, will be opened and widened according to the original program, to width of 80 ft.——Board of Public Works awarded to W. F. Hewitt & Co. contract for extending Harbor boulevard through Nob Hill, San Pedro; contract price, $77,680.50, and engineering and construction fees are estimated at $400.——Engineering Department has reported to Board of Public Works that repairs are necessary for the Downie-avenue bridge. Estimated cost, $3000. Bids will be called as soon as City Council authorizes the expenditure.——Board of Public Works is considering recommending that the city authorize construction of a highway on Alameda street for motor-truck service.——The Board of Public Works has awarded a contract to Benjamin F. Ford and Fred H. Stout for improving a section of Mateo street. Price $94,337.80.——Contract has been awarded to John Radich for sewers in Moneta Avenue district. Price $8200.

**MARYSVILLE**—The following bids have been received by the Board of Supervisors for the construction of the proposed new D street bridge over the Yuba river, of reinforced concrete: Leech & Decamp, San Francisco, $211,700; Shattuck, Edinger Co., San Francisco, $187,500; Ross Construction Co., Sacramento, $166,720; Van Sant, Houghton Co., San Francisco, $163,000; E. Rolandi, San Francisco, $155,000; Mathews Construction Co., Sacramento, $149,500; I. C. Evans, Marysville, $148,680; F. A. Keetit, $138,855; Clinton Fireproofing Co., San Francisco, $134,-000.——Bids have also been opened for the construction of the reinforced concrete bridge over Honcut creek: M. D. Groh & Son, Marysville, $7800; Chico Construction Co., Chico, $4770; Jenkin & Holmes, Chio, $3875.——Contract has been signed with the Clinton Fireproofing Co. for the construction of the D street bridge. Price $134,000.——The city sewer system is to be extended to a distance of 2½ blocks.——Irrigation District 10 has voted $100,000 bond issue to be used in raising levees and improving system.

**MERCED**—The County Board of Supervisors has awarded a contract to Mesmer & Rice for the construction of a bridge across the Merced river. Price $14,700. Other bidders were: C. L. Groesth, $16,161; Oscar Parlier, $18,385; the Midland Co., $15,575; O. A. Wilson, $17,550.——J. F. McSwain, as engineer, has prepared and submitted an estimate for the proposed municipal water plant. The total estimated cost is $136,113.20. ——Engineer G. H. Nickerson of the Yosemite Valley Railroad states that a new roundhouse will replace one destroyed by fire and will be built on the same foundation. Cost approximately $30,000. Structure will be frame building covered with armco iron covering 18,000 sq. ft., with nine engine stalls, blacksmith-shop, machine-shop, and paint-shop.——Board of Supervisors has awarded contract for bridge across Merced river to Mesmer & Co. Price $14,700.——County Surveyor, A. E. Cowell, has been authorized to purchase materials and complete bridge at Merced Falls, originally contracted to A. W. Biggers, who defaulted.

**MODESTO**—The City Council has ordered street paving on sections of Seventh street and alleys between 10th, 11th, G, and H streets; between 11th, 12th, G, and H; between 11th, 12th, I, and J; between 9th, 10th, J, and K; and between 10th, 11th, J, and K. Plans and specifications have been prepared by George Freitas, city engineer. Asphaltic concrete will be used. Plans prepared by the Commonwealth Engineering Co. for a reinforced concrete flume at Gasburn have been accepted by the Modesto Irrigation District. Thomas Berry, of San Francisco, is consulting engineer. Flume is to be 720 ft. long.—— The Board of Directors of the Turlock Irrigation District has appointed Claus Johnson as director of Division No. 4 for the Turlock Irrigation District.——Board of Education has adopted a resolution to vote $20,000 worth of bonds, October 31, for purchase of grammar school site.

**OAKDALE**—A call has been issued for a special election to take place on October 5 to provide an issue of $400,000 in bonds for the improvement and completion of the Oakdale Irrigation District.

**OAKLAND**—Plans and specifications have been presented by the county engineer for protection work for the Arroyo del Valle bridge on county road No. 2578. Estimate $1100. Bids for this work will be received until Monday, October 5, 10 a.m., at office of clerk of Board of Supervisors.——The County Surveyor has been directed to prepare plans and specifications for the construction of a bridge across San Lorenzo creek, on Hazel avenue, near Hayward.——The City Council has awarded a contract to the Oakland Paving Co. for constructing cement sidewalks on a section of Brush street; to the Oakland Paving Co. for the construction of a cement sidewalk on a section of Telegraph avenue; to the Oakland Paving Co. for the construction of a cement sidewalk on a section of Market street; to the Oakland Paving Co. for the construction of a cement sidewalk on a section of Wood street; to the Hutchinson company for the improvement of Edgerly street.——County supervisors have passed resolution authorizing repairing and improving all old county bridges.——Road work has been ordered on county road No. 1469 over Alameda creek and on road No. 2578 crossing the Arroyo del Valle.——The following contracts have been awarded: Crow Canyon road to D. V. Toffelmeire, price $2470; storm sewer, Castro Valley road, Hume, Clark & Frederick, price $900.55; Park Street bridge repairs, Hyde-Harjes & Co., price $1561.——San Francisco-Oakland Terminal Railways Co. has been given building permit to erect a $20,000 office building, corner of 22nd street and San Pablo avenue. ——Wm. Meredith has been given permit to erect store building at College and Telegraph avenues. Cost $10,000.——A bridge will be built on Hazel avenue over San Lorenzo creek. County Surveyor has been instructed to make plans.——An election will be held on October 26 for the purpose of electing directors for the newly formed Pleasanton water district.—— P. A. Haviland has prepared estimates of cost for a bridge across Arroyo del Valle. Price $1100.——City Council has directed city engineers to prepare proceedings for improving a section of 56th avenue.

**OROVILLE**—The Board of Supervisors has decided to proceed at once with the construction of a new Hall of Records. C. L. Kaiser, of Oakland, has been appointed architect. Estimated cost approximately $40,000.——United States Motion Film Co. will erect a one-story concrete building to cost $6000. Much plate-glass will be used. Freiflevin company has been awarded a contract for the construction of the building for O. A. Peter. ——The Board of Supervisors is considering the project of constructing a new Hall of Records at an estimated cost of $40,000.——Palermo Land & Water Co. has made four appropriations for additional water supply. One is for 1500 miner's inches on Fall river; one is for 150 inches on Belee creek; 500 inches on Big Dry creek; 250 inches on Bryant creek; making a total of 2400 inches. The ditch system is to be enlarged, and many other improvements are to be made.——B. F. Clark, of Yankee Hill, has appropriated 1000 inches upon Dogwood creek. An irrigation system is to be installed.——N. B. Master, of the Olive district, has appropriated 10 miner's inches of water for irrigation purposes.——Articles of incorporation have been filed for the Oroville Union Gold Dredge Co. Capitalization $65,000. Directors: J. G. Nisbet, W. H. James, Sam W. Cheyney, C. W. Putnam, all of Oroville, and J. L. Bradbury of San Francisco. A gold dredge is to be built.——The bond issue of $6000 for the construction of a new school in the Rio Bonito school district has been sold. Work will be commenced at once.——The Board of Trustees has passed a resolution providing for paving Lincoln street between Robinson and Montgomery, and also Bird and Robinson streets between Huntoon and Lincoln streets.

**PORTERVILLE**—The City Engineer has commenced work of

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grading a number of city streets. New pavements are to be installed.——I. H. Althouse, city engineer, has prepared plans and specifications for new street work on a number of city streets.——I. H. Althouse, city engineer, is preparing plans for a sewer system.——At the meeting of the Tulare County Highway Commission held in Woodlake, a favorable vote was made for the issue of highway bonds in the sum of $1,000,000.

**PORTOLA**—It is reported that the Western Pacific Railroad has placed a contract with H. M. Pitman, of San Francisco, for the construction of a complete sewer system.

**RED BLUFF**—County Surveyor Lunning will submit plans and specifications for four new bridges over the proposed highway from the Glenn county line to Corning. Structures will be steel and concrete. Approximate cost, $15,000.——Proposed bond issue for bridge construction has been defeated.

**REDDING**—The supervisors have let a contract to William Stevens, of this city, for the construction of 200-ft. span, all-steel bridge across the Pit river. Price $10,955. Other bids were: Mervy-Elwell Co., $13,187; M. B. White, $11,288; Chico Construction Co., $11,547.——The following officers have been elected for the Northern California Irrigation Association, which is to handle a Pit River project: M. T. Howell, of Cottonwood, is president; E. J. Shields, of Balls Ferry, vice-president; Roscoe J. Anderson, of Redding, secretary; W. C. Barkuloo, of Anderson, treasurer.

**RICHMOND**—The Board of Supervisors has approved plans for the construction of three steel and concrete bridges to be erected upon the new state highway, between Richmond and Pinole. Plans have been sent to the Highway Commissioners for approval before bids are advertised.——A scheme is about to be commenced for the irrigation of 14,000 acres in eastern Contra Costa county. Bids have been called for the removal of 30,000 cu. yd. of earth for the construction of three miles of irrigating canal. The Company is known as the Byron Bethany Irrigating Co., Volney Taylor, president, Ray R. Houghton, secretary.——The City Council has placed contract for the improvement of Soto avenue with Frank Aguiar. Price, $14,221.04. ——Council has instructed city engineer to install culverts in several city streets.——An ordinance has been passed by the City Council creating a city planning commission; the commission is to consist of seven men, with the city engineer and city attorney as members ex-officio. Plans and specifications for the new $50,000 Main Street school have been accepted by the Board of Education. Sealed bids will be called for.——A one-story brick building will be erected at the corner of 7th street and Macdonald avenue for Gold Bros. of Napa.——Carl Garhardt will erect a one-story frame building at Chanselor avenue near 20th street.——Mrs. A. H. Minor has secured permit to erect a one-story building on 16th street. J. O. Barker, architect.—— The City Board of Education will call for bids in a few days for the erection of a new school house at Grand boulevard and Clinton avenue. Estimate, $52,000.——City School Board has approved plans for Main Street school. Bids will be called.

**RIVERBANK**—The County Supervisors have decided to construct the public highway at once from Riverbank to Byrneyville.

**RIVERSIDE**—The County Board of Supervisors has let the first contract for a section of the new county highway; the section is from Box Springs to Perris, 9.3 miles in length. The successful bidder was Conners Construction Co. of Los Angeles. Price, $28,462.18.——Star Cement Co., 217 Loring block, lowest bidder for 2½ miles concrete paving.

**SACRAMENTO**—Notice has been given by city clerk that resolutions of intention No. 1085 and 1090 have been passed by the City Council providing for the improvement of a section of U street, and of the alley between W and X streets.——State Engineering Department has received bids for motor vehicle department: Automobile plates, chauffeur badges, and motor vehicle seals. The lowest bid received for automobile plates was Ingram-Richardson Mfg. Co., Beaver Falls, Pennsylvania. Bid was $50,898.75.——State Highway Commission has called for bids until October 5 for the following sections of the state highway: Folsom to the easterly boundary of Sacramento, 6.3 miles; Solano county, from Vacaville to Batavia, 8.2 miles; Santa Barbara county, from Stony creek to El Capitan creek, 10.2 miles; Santa Barbara county, from Divide to Orcutt, 3.6 miles; Humboldt county, from Shively to Jordan, 3.7 miles; Alameda county, from the eastern boundary to Altamont, 5.9 miles; Humboldt county, from Loleta to Beatrice, 4.3 miles; San Luis Obispo county, San Luis creek to Cuesta, 3.6 miles; Santa Barbara county, Zaca station to Los Alamos, 8.7 miles; Imperial county, Meters creek to Coyote, 6 miles; San Luis Obispo county, Atascadero creek to Paso Robles, 10 miles.—— The County Board of Supervisors has adopted a resolution calling for a bond election to take place on October 16, to provide $2,425,000 for the construction of new county highway.——The State Engineering Department has awarded highway contract as follows: Orange county, to White & Gaskill, of Long Beach, $37,935.50. The section in Colusa county has been awarded to C. L. Schaad, of Williams. Price, $67,145.20. Bids for section in Yuba county, Santa Barbara county, San Benito county, have been rejected.——A committee composed of S. Glen Andrus, chairman, C. H. Dunn, and B. S. Driver, has been instructed to prepare a petition under the Wright act to secure signatures for the formation of a new irrigation district.——Bids will be advertised for graveling 1.6 miles of road on Grand island. Bids will also be advertised for the construction of a reinforced concrete bridge across Alder creek.——Haviland & Tibbetts of San Francisco have completed a portion of the checking on the proposed county roads to be built under the $2,425,000 bond issue. The River road is treated under four sections; section 1 will be 6.55 miles long, 14 ft. wide, and of cement concrete with asphalt top; cost about $18,700 per mile. Section 2, 13.34 miles long, 14 ft. wide, built of gravel with asphalt top; cost about $10,000 per mile. Section 3, about 17.88 miles long, 12 ft. wide, to be built of gravel with asphalt top; cost about $8750 per mile. There will be two reinforced concrete bridges on this road to cost about $4800. Marysville road will be laid in two sections; section 1 about 4.71 miles long, 12 ft. wide, of cement concrete with asphalt top. There will be 10 reinforced concrete bridges costing $16,155. Total cost, $100,607. Lower Stockton road will be about 8.5 miles long, 12 ft. wide, made of cement concrete with asphalt top; cost $13,500 per mile. There will be six reinforced concrete bridges to cost $15,200. No. 4, Plymouth road, made in two sections; section 1, 7.44 miles long, 12 ft. wide, made of macadam; section 2, 7.34 miles long, 12 ft. wide, to be built of gravel. There will be seven reinforced concrete bridges to cost about $25,700. Total cost of this road about $106,721.——Contract has been awarded to the McGillivray Construction Co. for street work on M street. Contract has been awarded to the same bidder for another section of M street.——Resolution of intention No. 1087, for the improvement of a section of Donner avenue, has been passed by the City Council.——Bids will be received until 2 p.m., October 6, for grading 3.7 miles in Humboldt county, near Shively; for grading 4.3 miles in Humboldt county, near Beatrice; for construction of 5.5 miles of portland cement concrete highway in Alameda county; for grading 3.6 miles in San Luis Obispo county; for construction of 8.7 miles of portland cement concrete in Santa Barbara county; for the construction of 6 miles of portland cement concrete roadway in Imperial county. Bids will be received until 3:30 p.m., October 6, for the construction of 10 miles of portland cement concrete highway in San Luis Obispo county; 6.8 miles of portland cement concrete highway in Sacramento county; 8.2 miles of portland cement concrete highway in Solano county; 3.6 miles of portland cement concrete highway in Santa Barbara county; and for the grading of 10.2 miles in Santa Barbara county. Plans on file at Division Engineers' office at Willits, Dunsmuir, Sacramento, San Francisco, San Luis Obispo, Fresno, and Los Angeles. California Highway Commission, Sacramento; Charles G. Carleton, secretary.——Lowest bids received by the State Highway Commission and opened on August 31 were as follows: San Luis Obispo county, about 10 miles, estimate $71,-709.40; J. W. Calback, San Diego, $79,294.20. Orange county, about 7.4 miles, estimate $47,990.62; White & Gaskill, Long Beach, $37,935.50. Yuba county, about 3.3 miles, estimate, $19,-943.07; E. M. Whitlock, San Francisco, $24,303.80. Colusa county, about 12.6 miles, estimate $67,815.27; C. L. Schaad, Williams, $67,192. Kern county, estimate $86,125.23; A. C. McLean, San Francisco, $68,004.——City Commission has initiated proceedings for the formation of a sewer district in East Sacramento.——Residents are considering the establishment of a street-lighting district.——George T. Calder has been appointed an assistant city engineer.

**SAN BERNARDINO**—A county road bond election will be held in October to provide bonds in the amount of $1,750,000 for the construction of more than 400 miles of new county highways.

**SAN FRANCISCO**—Board of State Harbor Commissioners has awarded contract to Healy Tibbitts Construction Co. for the construction of Pier 37. Price $204,300.——Southern California Mountain Water Co. has applied to the California Railroad Commission for permission to sell its highland reservoir pipeline, in San Diego county, to the Coronado Water Co. for $165,350.94.——Southern Counties Gas Co. has asked for permission to operate a gas distributing system in the city of Santa Ana, Orange county.——Plans are in course of preparation by W. H. Weeks, architect, 75 Post street, for a 7-story steel and brick hotel, to be erected at Taylor and Folsom streets for Charles C. Judson. Cost $100,000.——Plans are being prepared by L. T. Hobart, Crocker building, for a unit of the Shredded Wheat Co.'s factory to be erected in Oakland.

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The building will be four-story reinforced concrete. Total cost of entire plant about $70,000.——R. N. Burgess, 742 Market street, desires bids on about 5000 yards of road work in Walnut Heights, Walnut Creek, California.——The Board of Works has elected Louis Mullgardt as architect for the new juvenile detention home to be erected on a city lot on Ocean street.——Monson Brothers turned in the lowest bid for the carpenter work on the new City Hall; amount, $167,154. Church & Clark put in the lowest bid for lowering and readjusting sewers in civic centre; price $12,000. S. M. Halstead put in lowest bid for drilling wells on the school lot at 42nd street; price $2600. Fairbanks, Morse & Co. put in lowest bid for machinery for municipal water works; price $1747. Fay Improvement Co. put in lowest bid for paving and curbing Fulton street; price $13,800.——The Board of Supervisors has authorized the following appropriations: Drilling well in Richmond district, $3000; sinking test well in Sunset district, $2500; improvement of municipal water works, $6405; mill work for city hall, $197,586; bedside tables for hospital, $3220; Glenn Park sewer, $15,000; library site in Sunset district, $7000; power plant in civic centre, $75,000; paving streets in civic centre, $180,000. The following street work has been ordered: Grading and constructing sewers on a section of 28th street; granite curbs and a 14-ft. central strip of basalt blocks and asphalt on a section of Roanoke street; granite curbs, 7-ft. strip of basalt blocks and asphalt on a section of 10th street; sewers in Lundy's Lane; sewers in 19th street; asphalt roadway in Moraga street; asphalt roadway in 18th avenue; asphalt roadway in 19th avenue.——The Board of Works has ordered paved the following streets: A section of Chestnut, Harrison, Arguello boulevard, Saint Rose's avenue, Chenery, and Lake View avenue. Sewers have been ordered for Raymond avenue, Valley, and Dwight streets.——Residential Development Co., West Gate Park Co., Balboa Terrace Co., will build an asphalt roadway 40 ft. wide between Sloat boulevard and Stanford Heights. Cost $60,000.——The California Debris Commission, Major L. H. Rand, has advertised for bids for additional rock for the wingdam system along the Sacramento river between the mouth of the Feather river and Freeport. Bids have also been asked for leasing to the Government a clam-shell dredging plant for excavating cut-off C in the San Joaquin river. ——Board of State Harbor Commissioners has approved plans and specifications for rolling doors and wood-block pavement on piers 16, 18, and 37 adopted, and bids will be called soon. ——The Board of Supervisors has requested that the Board of Works makes estimate of cost for installing a power plant within the civic centre.

**SAN LEANDRO**—Plans and specifications for a comprehensive scheme of street improvement have been prepared. Work will be started almost immediately under the direction of Joseph Peralta, street superintendent.

**SAN LUIS OBISPO**—The Board of Supervisors will replace a 100-yd. wooden bridge at Mile station with a modern structure. A new bridge is to be built across the Salinas river near San Miguel. Several other smaller bridges will also be built.

**SAN JOSE**—The County Board of Supervisors has adopted plans and specifications for the construction of an exhibit facade for the Coast Counties exhibit in the California building at Panama-Pacific exposition. Bids will be opened October 19, 11 a.m.——The City Council has ordered the construction of curbs and gutters on a section of Pine street.——Bids have been called by Henry A. Pfister, city clerk, for improving University avenue. Bids will be opened at 11 a.m., October 5.—— Bids have been called by Henry A. Pfister, clerk of the County Board of Supervisors, until October 5, 11 a.m., for the construction of a reinforced concrete arch bridge over Los Gatos creek, at the Infirmary road.——A project is under way to erect electroliers on West Santa Clara street.——A resolution has been passed placing contract with the Ransome-Crummey Co. for the construction of the crossing at 12th and Santa Clara streets.——Plans and specifications for paving Julian street from 4th to 17th streets have been presented and accepted.——Contract is to be awarded to John W. McDonald, Jr., for furnishing material and labor for paving San Augustin and Grand street bridges. Price 12.9c. per square foot.——Contract has been awarded by City Council to Joseph Birkett for the construction of a reinforced concrete bridge over Adobe creek at Felix avenue. Price $1215.——A contract has been awarded to Ransome-Crummey Co. for paving a section of 5th street.——A contract has been awarded to Chas. W. McDonald, Jr., for paving a section of 12th street; his bid was 20c. for grading and paving, 50c. for curbs, 20c. for gutters, 8c. for pipe at crossing, additional, and $50 for catch-basins.

**SANTA ANA**—Crandall Construction Co., San Fernando building, Los Angeles, awarded contract for constructing approximately 2¾ miles of section 2, Calvin road, County Highway specification bid $5507.53.

**SANTA BARBARA**—The County Supervisors have decided to proceed with the proposed bond issue for county highways under the Savage act, which provides for the appointment of three highway commissioners, who will select their engineer, outline plans, and have charge of construction should the bonds be voted.——The contract between the city and the Mercereau Construction Co. for the construction of the city seawall has been signed.——The County Board of Supervisors has approved the project for road building in the county recommended by citizen's committee of fifteen. Surveys are to be made at once for the following: San Marcos road from foot of grade south to Los Olivos; Foxen Canyon road, Los Olivos, to intersection of Kern County road at Tebusquet crossing to Kern County lines; Foxen Canyon road, Tebusquet crossing to Santa Maria; Guadalupe road, Santa Maria, to Guadalupe; Alisal road to Los Olivos, Ballard, Soldang, to Nojoquil; Los Olivos to Zaca station, connecting with state highway; Central avenue, Goleta district, connecting with Modoc road, one-third mile; Fairview avenue, Goleta, one mile; from main road to Southern Pacific, Goleta, depot, one-third mile; Patterson road, Hollister avenue, to Cathedral Oaks; the Mountain drive, East Valley road, to Toro canyon, 3½ miles; Foothill road, Carpinteria, 4½ miles; Casitas road, Rincon grade, 1⅛ miles; Santa Monica road, Post highway, Foothill road, ¾ mile; Santa Rita road from Four Corners to Soldang; San Julian road, Santa Rosa road, Lompoc to state highway at Santa Ynez crossing; Lompoc to Paris station; Ocean View avenue, Lompoc to Surf; Central avenue, Lompoc to river, 5 miles; San Miguelito Canyon road, Lompoc to La Honda. It is further recommended that a sum not exceeding $50,000 be provided for the construction of the bridge across the Santa Ynez river, in section D of the highway, and also that a competent engineer be appointed to supervise the execution of all of the work.——Carnegie Library trustees have accepted plans by Francis W. Wilson for city and county library. Estimated cost $50,000. Options on three possible sites have already been secured.—— Contract has been awarded to W. F. Hewitt Co. for first section of West sub main artery road. Price $42,489.92. Other bidders: Bent & Pennybaker, $42,752.75; Fairchild-Gilmore-Wilton Co., $44,489.15; Modern Construction Co., $47,325.12; California-Arizona Construction Co., $52,938.20.——Representatives of the various civic organizations are holding a series of conferences with respect to recommending a general bond issue for the improvement of county highways.——It is stated that the election to vote bonds for the construction of the 300-mile Santa Barbara County road system is to be held in January. Estimate of cost and determination of types of road to be installed are being made.——Rogers Bros. Co., 350 Merrick street, Los Angeles, has been awarded contract for constructing approximately 6200 lin. ft. of oil macadam paving on Broadway, Santa Maria, for the county commission.——F. R. Ritchie & Co., Chronicle building, San Francisco, awarded contract for paving Valerio street. Contract $47,919.63.

**SANTA CLARA**—V. A. Schiller will erect a new building of brick, with concrete floor and concrete front, 51 by 120 feet.

**SANTA CRUZ**—Contract has been awarded to Petersen & Watson of San Francisco for the construction of the new reinforced concrete high school. Price $79,750. Other bidders were Thurston & Co., San Francisco, $90,140; Howard S. Williams, San Francisco; $89,800; Harry A. Klyce, San Francisco, $79,980; Robert Trost, San Francisco, $88,450; P. J. Lynch, San Francisco, $84,468; Collman & Collman Co., San Francisco, $92,000; C. P. Building Co., San Francisco, $88,998; Foster Vogt Co., San Francisco, $87,587; George W. Reid, Santa Cruz, $84,290; Williams Bros. & Henderson, San Francisco, $81,300.——Plans prepared by Commissioner F. R. Howe for piping water on the municipal pier have been adopted by the City Council; estimated outlay, $2543. Electric lighting standards in the Mission style are to be installed on the pier about 60 ft. apart. Each standard will carry a 150-watt lamp.——Plans and specifications for the Seaside and Delaware Avenue sewers have been adopted.——City Council has awarded a contract for the construction of the Blackburn, Neary, and Felix streets sewer to L. T. McFadden; price $1394. The City Council has passed an ordinance providing for street improvements and new sidewalks to unite the new concrete bridge at Water street with that of the Union Traction Co.——F. W. Bliss, president of the Board of Library Trustees, has called for bids until 5 p.m., October 6, for the construction of a library building in Garfield park.

**SANTA ROSA**—Sonoma county, at the general election in November, will vote upon a bond issue of $1,600,000 for the construction of new county roads. Hunter & Morton are engineers.——The county clerk has advertised bonds for sale to provide funds for the erection of a new schoolhouse in the Piner School district.——City Council has awarded a contract to the Bayley-Comstock Co. for laying concrete curb and gut-

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ters on 14th street. Price 75c. per lineal foot.——The city engineer has been authorized to make plans and specifications for curb and gutter between A street and the Northwestern Pacific depot.

**SAUSALITO**—The City Trustees will advertise for bids for grading a section of the new street work in accordance with recent bond issue of $100,000. George Hool is city engineer. C. M. Gunn is mayor.

**SIERRA MADRE**—The issue of $12,500 school bonds recently passed by the voters has been declared illegal.

**STOCKTON**—The following bid has been received for the construction of a portion of Jack Tone road between Linden road and Tokay Colony: Silas Moreing, grading $2864.40; shaping subgrade and placing gravel, $1.65 per ton; installing corrugated pipe culverts, $5 each. Bids have been submitted for improving a section of McKinley avenue as follows: David McDonald, grading $3468; gravel in place, $1.55 per ton; culvert in place, $70. A. B. Munson & Son, grading $3000; gravel in place, $1.59 per ton; culvert in place, $80. Silas Moreing, grading $2049.20; gravel in place, $1.40 per ton; culvert in place, $75. Irey & McCleary, grading $2561.50; gravel in place, $1.48½ per ton; culvert in place, $75. The following bids have been submitted for improving a section of West lane: A. B. Munson & Son, grading $187.50; gravel in place, $1.75 per ton. Silas Moreing, grading $150; gravel in place, $1.65 per ton. Irey & McCleary, grading $75; gravel in place, $1.75 per ton. Contracts have been awarded to Silas Moreing for improving a section of Jack Tone road, McKinley avenue, and West lane.——The county surveyor has been instructed to prepare plans and specifications for improving a section of C. A. Howard road.——A petition has been filed for the construction of a bridge across Stanislaus river and Burneyville. A petition has been filed asking for the improvement of a portion of Austin road. A petition has been filed for improving a portion of Jack Tone road near Vernon station and Five Corners.——The City Council has received bids for paving Webber avenue from American to East streets; 2-in. asphalt macadam wearing surface on a 3-in. concrete base from American to Union street, and on a 2-in. concrete base from Union to East street are to be used. The bidders were Clark & Henery, $22,154.85; Federal Construction Co., $26,316.12; Guy T. Covault, $28,500; A. B. Munson, $28,500. Estimate of H. T. Compton, city engineer, $28,404.40.——A communication was received from Warren Brothers to the effect that the specification called for a type of construction in accordance with their patents, and that they would hold the City Council responsible for royalty due on the work.——City Council has awarded contract to James Mulcahy for reinforced concrete bridge at Sutter street. Price, $13,680.——The Commercial & Savings Bank has let the following contracts for its new 10-story building: Ornamental iron and metal work, Monarch Iron Works, Stockton, $16,784; electrical work, Standard Electric Construction Co., San Francisco, $4742; plumbing, drainage, and gasfitting, Hately & Hately, San Franisco, $10,119.——W. C. Gaskell awarded contract for laying concrete sidewalks around Jackson and North schools, by board of Education. Bid was 12c. per square foot. Price of contract not stated.——Plans and specifications for a bridge over the Calaveras river on the W. D. McAllen road have been presented and filed.

**SUNNYVALE**—Plans and specifications for the water system have been submitted to the City Council by the city engineer.

**SUSANVILLE**—Plans prepared by the Bradley Construction Co. for reinforced concrete bridge across Susan river have been accepted by the Town Trustees. Estimated cost $2200.

**TERRA BELLA**—Charles Camp, of Greeley, Colorado, with M. C. Hinderlider as engineer is working for the formation of a new irrigation district near this town. The project involves the impounding of the water of Deer creek for the purpose of irrigating the orange, lemon, and olive lands within this section. A diversion dam is to be built at an estimated cost of $46,000.

**TURLOCK**—T. A. Owen, of Hughson, has been elected president of the Board of Directors of Turlock Irrigation District. ——City clerk has been notified that, due to legal technicalities, the successful bidders for $15,000 in bonds for fire equipment have recalled their bids. It will probably be necessary to call another election.

**WATSONVILLE**—The Turner-Dahnkin Co., of San Francisco, will construct a new theatre of reinforced concrete. W. H. Weeks, of San Francisco, architect. Estimated cost $40,000.

**WILLOWS**—Petitions have been circulated asking that the city form three new sewer districts. The three jobs will be done under the Vrooman act, and cost about $25,000.——Bids for new postoffice will be received for a building to cost $75,000. Address Treasury Department, Washington, D. C.—— The supervisors have announced their intention of levying a special tax to provide $60,000 for the construction of a bridge across the Sacramento river at Princeton. Colusa county will contribute the balance, making the total cost of the bridge $144,000.——Plans are under consideration for the formation of a new sewer district.

**WOODLAND**—The City Board of Education has ordered plans for a new school to replace the Walnut Street school which was destroyed by fire.——The county has objected to the construction of a wooden bridge over the Knights Landing ridge, and insists that a permanent bridge be made of reinforced concrete.

**YREKA**—H. S. Wooley is promoting the construction of a narrow-gage railroad from Crescent City, Del Norte county, to Yreka. The road is to connect with Medford, Oregon. A stock issue of $5,000,000 is contemplated.

**YUBA CITY**—The supervisors are considering calling a bond election in November to provide funds for the construction of a bridge across the Feather river at Nicolaus, at a cost of $110,000. The bridge will be about 2800 ft. long.——The County Board of Supervisors is considering plans for the construction of a bridge over the Bear river near this city. Estimated cost is approximately $150,000. A road is also to be built at a cost of $120,000 to connect this city direct to Sacramento.

## OREGON

**ASTORIA**—Marconi Wireless Telegraph Co. will erect large wireless telegraph station here soon. Four steel towers will be erected on concrete foundation. Estimated cost, $80,000.

**BAY CITY**—Tillamook Bay Construction Co. has been awarded contract for paving and surfacing 24 blocks of street. Contract $36,007.47. Twelve blocks will consist of 16-ft. portland cement concrete centre with macadam to the curb.

**BURNS**—Election will be called to vote on $100,000 bonds for construction of water and sewer system.

**BAKER**—Bids will be received for the construction of a new Latter Day Saints church at South Baker. Jos. Barton is chairman of building committee, and M. P. White, architect.

**EUGENE**—City Council is considering an ordinance for paving 6th avenue for a distance of 10 blocks.

**GRANTS PASS**—A proposal from Rogue River Water Co. involving the purchase by the city of the water system by which the municipality is served, has been presented to common council. Price $125,000 for system, agreeing to take in payment the bonds of the city at 5½% interest.

**HOOD RIVER**—The County Court has awarded contract for construction of Columbia Highway between Multnomah line and Viento to the Newport Land & Construction Co. Price $58,000.——The County Court has been petitioned by the Upper Valley Good Roads Association to appoint an engineer for the purpose of making a survey of the proposed loop highway to penetrate the Upper Valley.

**MILWAUKEE**—The City Council has issued orders providing for the improvement of Front street at a total cost of $44,000.

**PORTLAND**—Following bids for street and sewer improvements have been opened by the city commission: Extension of Holgate-street sewer, vitrified pipe; J. F. Shea, $23,638.32; Azar Construction Co., $17,561.21. Improvement of section of Cornell street: Warren Construction Co., $20,070.35. Improvement of section of Morrison street: Oregon Independent Paving Co., $5647.85 asphaltic concrete, and $6041.45 asphalt; Warren Construction Co., bitulithic on concrete base, $7222.12; Oscar Hubber, asphalt $6335.24, and asphaltic concrete $6138.44. Improvement of section of Omaha avenue: Manning & Co., grading and sidewalk, $13,225.10; Keenan Bros. Co., $12,443.30; Cochran-Nutting Co., $11,240.71; Bodman & Burge, $11,247. Improvement of section of Montgomery Drive: Warren Construction Co., $11,917.94, gravel bitulithic; Manning & Co., concrete, $10,864.76; Oregon Hassam Paving Co., class B Hassam, $12,-621.48.——The City Council has granted a 25-year franchise to the Portland & Oregon City Railway Co. for operating an interurban electric line from Clackamas county to the west side business district of Portland via E. 22nd street.——The Oregon-Washington Railway & Navigation Co. will erect immediately a modern dock, 560 ft. long by 120 ft., north of the site of the Oceanic dock. A sprinkler system and fire walls will be installed. J. R. Holman is chief engineer for the Company.——The City Commissioners have ordered that water users in the Bull Run district install water meters by December 1.——City Commission has awarded contract to the Oregon Hassam Paving Co. for paving section of E. Lincoln street with class B Hassam. Price $17,156.07.——City Commission has received the following bids for improvements of sewer system on E. 78th street: Edward Sandeberg, vitrified pipe, $7686.90; Azar & Co., cement pipe, $6334.20; Keating & O'Neill, vitrified pipe, $7584.64. For construction of sewer system on E. 7th street and E. Yamhill street: Edward Sandeberg, vitri-

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fied pipe, $10,336.84; George Gordon, vitrified pipe, $9468.42; Keating & O'Neill (pipe not specified), $10,436.35; Azar & Co., cement pipe, $8591.73.——St. Mary's hall was completely destroyed by fire; estimated loss was $40,000; fully insured. They are undecided whether they will rebuild on this site or seek another.——Recommendation has been made to the City Council to award contract for sidewalk work as follows: The section of Going street to O. Paulsen; price $528.26; Delaware avenue, to O. Paulsen, $1273.25; Beacon street, to Giebisch & Joplin, $972.10; 66th street, to Keenan Bros. Co., $1631.36.—— $300,000 in municipal ten-year 6% street and sewer improvement bonds have been sold.

**SALEM**—Bids will be received by Charles F. Elgin, city recorder, until 7 p.m., October 5, for construction of pavement in alley in block 3, to be built of either concrete pavement 6 in. thick or El Oso pavement No. 1, 4-in. cement base with 2-in. El Oso top pavement No. 2, 4-in. concrete pavement 1½ in. according to plans and specifications now on file.——Rock crushing plant of Cascade Construction Co., capable of producing 600,000 cu. yd. of rock is now in full operation.

**SUTHERLIN**—The Roach Timber Co. has placed a contract with McAllister & Son Construction Co., of Portland, for the first 28 miles of the Sutherlin, Coos Bay & Eastern Railroad. ——The Lumberman's Engineering Co., of Portland, H. D. Haley, chief engineer, is investigating the feasibility of the proposed extension of the line through the north Umpqua River canyon and pass in the vicinity of Diamond lake.

**WARRENTON**—Council grants Pacific Power & Light Co., Astoria, 30-year franchise to furnish power and light in the city. Estimated cost of extension, $50,000.

## UTAH

**LEHI**—The Provo River Reservoir Co. has decided to make extensive improvements to its pumping plant near Saratoga Springs. Plans call for extending present building 60 ft. and adding six 400-hp. pumps with a capacity of 20 second-feet each; two 30-in. wood stave pipe-lines are to be installed, each 2300 ft. long. Joseph Broadbent has charge of the projected improvements.

**PROVO**—Following bids have been received by the County Commissioner for building two steel bridges over Provo river, one at Pleasant View, and one over Jordan river: Provo Foundry & Machine Co., Provo river $4050, Jordan river $6100; James J. Burke Co., Provo river $3498, Jordan river $5244; Levy Construction Co., Provo river $4678, Jordan river $5087; Midland Bridge Co., Provo river $4020, Jordan river $4380; Minneapolis Steel & Machine Co., Provo river $4144, Jordan river $4774; Parrott Bros. Co., Provo river $4527. Bids have been taken under advisement.

**SALT LAKE CITY**—Henry C. Ulen, of Chicago, is lowest bidder for construction of sewer extension No. 328 for building of 67 miles of new sewers. Estimated cost $883,617. Other bidders: P. J. Moran, E. A. Heman, and James Kennedy.—— State Road Engineer, E. R. Morgan, 321 Felt building, announces that two new bridges will be built in Utah county; that additional road improvement will be made in Beaver county; and additional grading and culvert work in Sanpete county.——Contract and bond of Henry C. Ulen for sewer extension No. 382 has been approved by the City Commission; about seven miles of sewer is to be constructed at a cost of $671,000.——E. R. Morgan, state engineer, has recommended the construction of 2 miles of concrete road for the state highway through the Garfield district.——The city of Beaver has purchased the Beaver Water Works system from Harry S. Joseph for $40,000. Mr. Joseph has obtained a franchise for the Kanas and he will commence work of installation this fall.

## WASHINGTON

**ABERDEEN**—City Engineer has been ordered to prepare estimates of cost of building trunk sewers in district west of Division and east of Hoquiam.

**CATHLAMET**—City Council has taken first steps for installation of municipal electric light plant. Distillate engine as prime mover will be used first. Water power site on the Elocaman river 10 miles from city will be developed.——Preliminary plans have been made for construction of complete city sewer system.

**COLFAX**—County Commissioners have decided to construct two steel reinforced concrete bridges at Elberton and Colfax over the North Palouse river. A reinforced concrete bridge is to be constructed jointly by the city and county on Morton street.

**LEAVENWORTH**—Contract has been awarded to C. A. C. Mill Co., of this city, for cutting 6000 cords of western red cedar shingle bolt timber in the Wenatchee National Forest.

**OLYMPIA**—The City Council has passed an ordinance providing for the installation of water mains in the new paving district south of 7th street. Both wood and cast iron mains will be used.——The Supreme Court has decided that the issue of $75,000 bonds made by the county of Hood river for their portion of the Columbia River highway, is valid. Bond issue of $25,000 made by the city of Eugene has also been declared valid.——The State Land Board has postponed action on proposition to dike an area on the southern tip of Willapa harbor.

**PUYALLUP**—The City Council has decided to submit bond issue of $10,000 in December to provide funds for fire department equipment.

**SEATTLE**—The City Council has passed resolutions for improving sections of 29th avenue, 8th avenue from Olive street to Stewart street.——An appropriation of $10,000 has been made to permit the city engineer to prepare plans and specifications for the proposed Ballard bridge over the Lake Washington canal.——The joint board of commissioners of King and Pearce counties has decided to buy a dredge for the excavation of 2,750,000 cu. yd. of dirt on the Stuck river.——A contract has been awarded for the work to Rollins, Cross & Co., of Seattle, at a price which will amount to approximately $239,650, including the net cost of the dredge. The contract price per yard is 7.3c. for the Murphy cut-off and Puyallup work at 10.95c. per cu. yd. for the Roesli cut-off. Estimated cost of dredge is from $68,000 to $70,000 for an 18-in. electrically operated dredge. Bids for this will be received for the board by W. J. Roberts at Tacoma.——Board of County Commissioners will receive bids until October 20 for construction of Medina Bellevue road, permanent highway No. 9. Plans and specifications on file at office of County Commissions, Court House.——Low bid for furnishing gantry crane for Smith Co. project, port of Seattle, was submitted by Shaw Electric Crane Co., Muskegon, Michigan, $40,921, with alternate bids of $38,590. Other bidders: Brown Hoisting Machinery Co., $48,200; Toledo Bridge & Crane Co., $52,500.——Board of Commission has opened bids for building Spokane avenue cold-storage warehouse as follows: Proposals call for bids in the alternative, first for building only half of the structure, and then for the structure completed: Sound Construction Co., $237,738, $136,906; Kieburtz & Smith, $138,100; Brandt Construction Co., $201,452, $137,500; Pearson Construction Co., $164,895, $114,997; Blume, Smith Co., $219,300, $166,596; Hans Pedersen, $196,975, $133,300; Ferro Concrete Co., $190,000, $132,800; Nettleton, Bruce & Ashback, $206,911, $144,000; Wellington Peters Co., $250,650, $163,110. No award made at that meeting.——Bearance & Cleaver have submitted the lowest bid for the cut-off on the Stuck river. Price $43,460. Unit bid, 15c. per cu. yd. for 250,000 cu. yd.; piling to cost $1800; lumber the same amount; ironwork, $210; clearing, $400; driftwood, $1750. Other bids were: E. M. More, of Tacoma, $49,785; C. E. McHugh & J. P. Wright, of Tacoma, $59,815; W. J. Roberts, the chief engineer for the inter-county river project.——Port Commission awards contract to Balfour, Guthrie & Co. for furnishing 7500 bbl. of portland cement to be used in east waterway work.——The following resolutions for improvements of city streets have been introduced by the City Council: A section of 32nd avenue and a section of West 57th street. The City Council is considering the improvement of Northlake avenue. The County Commissioners have granted a franchise to the Municipal Light Plant for the erection and maintenance of a light and power line from Bryn Mawr to Renton along the line of State Aid Road No. 7.——Bids have been called by the Port Commissioners for the construction of an eight-story reinforced concrete cold-storage warehouse, 170 by 190 ft. Estimated cost, including equipment, $460,000.—— Port Commission has awarded contract to the Butler Construction Co. for erecting the grain elevator and track scale on East waterway for $197,900 and for the wharf on south side of turning basin. Price, 76,151.——The street committee of the City Council has approved a resolution of intention to pave a section of Pike street with asphalt. The present brick pavement will not be removed.

**SPOKANE**—The Northern Pacific Railway and the Washington Water Power Co. have agreed upon diversion of traffic at Sprague avenue and Division street. A temporary frame bridge 1000 ft. long costing $25,000 will be built. Chief Engineer Carl Uhden represents the Washington Water Power Co.——Trust deed has been filed by International Portland Cement Co., in favor of North West Trust & Safe Deposit Co., Seattle; Company plans to expend $150,000 of the $400,000 installation of rotary motors. Morton Macartney, city engineer, is acting as consulting engineer for the city of Hillyard with reference to drawing specifications for paving four blocks on Market street. ——The Commissioners of Public Works have recommended that contract be awarded to C. M. Payne for constructing a combination curbing and gutter on Park and Waverly place. Price,

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$5884.50.——Construction of lateral sewer in the alley between Nora and Augusta avenues to O. Johnson & Co. Price, $1952.50.

**TACOMA**—The City Council has passed resolution No. 6418 for the improvement of an alley between L and M streets—— Bids have been called by the commissioner of light-houses, Washington, D. C., until 2 p.m., October 12, for the construction of a steel steam light-house tender.——Initial resolution No. 6411 for grading, curbs, gutters, and sidewalks on a section of South 66th street has been adopted. Initial resolution No. 6409 for cement and concrete sidewalks on a section of North 29th street has been adopted. Initial resolution No. 6410 for sidewalk improvements on a section of McKinley avenue has been adopted. W. D. Nickeus, city clerk.——The entire plant of Carsten Packing Co. on tide-flats was destroyed by fire. Estimated loss, $700,000. Municipal railway on tideflats department will shortly advertise for ties for the lines, and later for trolley wires, poles, and general overhead equipment. Track will be laid by day labor.——The City Council has appropriated $5000 to clear the stream at La Grande of rock which obstructs the flow into the city power-plant and for the construction of protective rip-rapping. Wood water mains at Fernhill are to be extended at a cost of $1989.

**VANCOUVER**—As Multnomah County bridge bonds have not been sold, Clark county bonds will not be offered for sale, and construction of Columbia River interstate bridge will be postponed.

**WALLA WALLA**—The committee has recommended the use of gravel bitulithic for paving Clinton, Alvarado, and Estrella streets.

**WENATCHEE**—County Commissioners are considering the purchase of a steam-shovel.

**YAKIMA**—Improvement district has been formed covering 3000 acres of land and bond issue of $90,000 has been voted for reconstructing flumes and general improvement throughout the district. About three miles of metal flume will be constructed. Sale of bonds handled by Robert & Udell, lawyers, National Bank building, North Yakima. U. S. Reclamation Service will expend $40,000 for the work of rip-rapping all portions of the Sunnyside canal built on fills for a distance of 50 miles. The work is to be done this fall and winter.——Authority has been received by local offices of U. S. Reclamation Service ordering immediate construction of two additional pumping plants at Outlook and Grandview, and also the pumping plant at Snipes Mountain; $50,000 additional has been appropriated for pumping plant construction, making a total of $340,000 available from the reclamation fund.——Bonds have been voted by both the Grandview and Outlook district.

## Personal

JOSEPH BENSON has opened offices as consulting engineer at 208 Judge building, Salt Lake City.

C. R. SPRUNG, of Taft, California, has accepted a position with the Indo-Burma Oil Co., of Upper Burma, India.

J. H. DOCKWEILER has been retained as municipal supervising water expert for the city of Oakland, California, for the year 1915.

GEORGE A. POSEY, chief deputy surveyor for Alameda county, was married on September 16 to Miss ETHEL H. KESSELRING of San Francisco.

J. F. LUCY Co. has announced the removal of its general offices from 50 Church street to the Woolworth building, 233 Broadway, New York.

HENRY W. MCCRAY, of Bakersfield, has been appointed Kern County surveyor by the Board of Supervisors, succeeding the late M. W. BUFFINGTON.

HENRY Z. OSBORNE, Jr., a member of the city engineer's staff at Los Angeles, California, has been appointed a member of the Board of Public Works.

A. M. GILBERT, engineer for the U. S. Reclamation Service, reports that the Beaver River irrigation project in Utah has completed construction of a new dam.

Professor CHARLES GILMAN HYDE, of the University of California, has been investigating the new sewer systems recently installed in Tulare and Lindsay, California.

C. DE VERE FAIRCHILD, assistant city engineer for the city of Yakima, Washington, is preparing data for a comprehensive system of street improvements to be commenced in the spring of 1915.

ROBERT W. HUNT & Co., LTD., reports the removal of its Vancouver, B. C., offices and testing laboratories from the Bank of Ottawa building to the Standard Bank building, 508 Hastings street, West.

JOSEPH JACOBS, consulting engineer, of Seattle, and president of the Pacific Northwest Society of Engineers, has been in San Francisco recently as an expert witness in litigation involving technical matters.

FRANK C. MILLER has been appointed city engineer for Sacramento, California, succeeding ALBERT E. GIVAN, resigned. Mr. MILLER was graduated from the Ohio State University School of Civil Engineering in 1893.

PAUL P. WHITHAM has resigned his position as chief engineer for the Seattle Port Commission to become associated with GEORGE WATKIN EVANS in general consulting practice, with offices at 423 New York block, Seattle.

JOHN N. EDY has been appointed assistant city engineer for Billings, Montana. Mr. EDY is a graduate in civil engineering of the University of Missouri and has been engaged in railroad construction and also served for some time as county engineer for Butler county, Missouri.

C. C. BONEBRAKE has been appointed city engineer at Santa Ana, California. Mr. BONEBRAKE was graduated from the engineering department of the Kansas State Agricultural College in 1909 and became city engineer of Orange, California, in April 1912, which position he will continue to fill.

CHARLES H. LEE, consulting engineer of Los Angeles, has been engaged by the Ground Water Division, Water Resources Branch, U. S. Geological Survey, to carry on comprehensive investigations of ground water-supply throughout the Pacific Slope drainage of San Diego county. Mr. LEE will maintain his engineering offices in the Central building, where he will continue his consulting engineering practice.

## Commercial Paragraphs

JOHN J. BLAKELY is laying a demonstration block of Westrumite pavement for the United Railroads on Kentucky street, near Merrimac, San Francisco.

THE ROADAMITE PAVING SUPPLY Co. has recently purchased a 12-ton 2-cylinder Austin road roller for use in the execution of its contracts for road building in San Mateo county.

THE DENNY RENTON CLAY & COAL Co. of Seattle has opened San Francisco offices at 221 Sharon building. C. S. Laumeister, with the Board of Public Works of San Francisco is in charge.

The photograph of the AMERICAN WELL WORKS centrifugal pump described in the Industrial Progress section of this issue was taken by the Towers company, commercial photographers of San Francisco.

The first gasoline tandem road roller to be used in California has been sold to the California Railway Commission through the San Francisco office of the AUSTIN WESTERN ROAD MACHINERY COMPANY.

THE HENRY COWELL LIME & CEMENT Co. will soon move into its new building on the corner of Market and East streets, San Francisco. Obviously Mt. Diablo portland cement and lime were used exclusively in construction.

THE SAN FRANCISCO MUNICIPAL ENGINEERING & CONTRACTING Co., 473 Sixth street, San Francisco, is the Pacific coast representative for the Austin cube mixers. A. M. Skillman has come from Chicago to assume management for the Company.

THE GRANT GRAVEL Co., Williams building, San Francisco,

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reports that it is shipping 14 carloads per day of its concrete mix. This Company was one of the first to offer concrete aggregate correctly proportioned with a guarantee of not to exceed 25% of voids.

THE AUSTIN WESTERN MFG. CO. through its San Francisco office has recently sold to A. Dougherty of Los Angeles a 500-ton daily capacity rock crushing plant which is now being installed in San Luis Obispo county for use in filling a number of road contracts.

THE CITY OF SAN FRANCISCO has purchased two gasoline driven No. 5-A Foote paving mixers for use in the street repair department. A No. 6-A Foote paver has been delivered to George R. Curtis for use in filling a paving contract in the city of Los Angeles.

R. F. WARE, 301 California building, Los Angeles, has just been awarded a contract for digging 170 miles of ditch for the Valley Pipe Line Co. Sanderson & Porter, San Francisco, are the engineers. This is probably the largest ditching contract of the year. Buckeye trench excavators will be used exclusively.

It is reported that the 20-ton Ohio locomotive crane with 50-ft. boom purchased by the GRAFF CONSTRUCTION CO. for use on the construction of the Yolo basin by-pass for the California Highway Commission has arrived at Webster, California, where it is being used in unloading reinforcing steel and other construction material.

EDWARD R. BACON CO., of San Francisco and Los Angeles, has issued bulletin No. 10 describing the Wallace concrete and lumber hoists. This Company has purchased patents and all manufacturing rights for the Wallace apparatus, formerly manufactured by the Wallace Concrete Machinery Co. of Los Angeles. The Company has also reported the sale of a rapid heater mixer to the city of Berkeley for repairing asphalt pavements.

The Seattle office of CHARLES C. MOORE & CO., ENGINEERS, has sold to the Carbon Hill Coal Co. a 6-in. 6-stage Platt Iron Works centrifugal pump. This type of pump is being used to a greatly increased extent by mining companies. The Company has also sold a 50-in. Platt Iron Works centrifugal pump to Natomas Consolidated, making a total of 13 pumps of this size and make sold within 15 months in the Sacramento Valley territory.

CHARLES C. MOORE & CO., ENGINEERS, of San Francisco, report the consummation of a contract with the city of San Diego for two 40-in. 4-stage Platt Iron Works turbine pumps for the municipal pumping plant. The same Company has also reported the sale of a 6½ by 15 triplex direct motor driven pump and two 6-in. 5-stage direct motor driven pumps to the Goldfield Merger Mines Co. of Goldfield, Nevada. The triplex pumps are to operate against a head of 1525 ft., while the centrifugals are the first mine pumps of this type to be operated in the Goldfield district.

## Catalogues Received

CATERPILLAR TIMES, Holt Mfg. Co., Stockton, Cal., issue for July 1914.

THE NATIONAL HIGHWAYS ASSOCIATION, Washington, D. C. Bulletin and map.

W. S. TYLER CO., Cleveland, Ohio. Catalogue illustrating and describing testing sieves.

CITY OF LOS ANGELES, Cal. Provisional Report of Board of Engineers on flood control, June 3, 1914.

WATSON WAGON CO., Canastota, New York. Illustrated catalogue descriptive of Watson grading wagons.

FULTON IRON WORKS, St. Louis, Missouri. Illustrated catalogue on the Fulton-Tosi oil engines, Diesel type.

DAN E. ERICKSON, 678 Second St., San Francisco. Illustrated pamphlet on the Erickson patent oil fuel furnace.

W. A. BREMER, 1926 Sacramento St., Los Angeles, Cal. Catalogue, illustrated, concrete machinery and accessories.

CHAIN BELT CO., Milwaukee, Wisconsin. Illustrated catalogue on 'Chabelco' steel chain belt. Catalogue No. 54.

THE GUN-CRETE CO., McCormick Bdg., Chicago. Illustrated pamphlet by Carl Weber on the cement-gun and its work.

THE YUBA CONSTRUCTION CO., 433 California St., San Francisco. Illustrated catalogue of the Yuba ball-tread tractor.

G. W. PARSONS CO., Newton, Iowa. File for bills, letters, and legal paper. Langford, Felts & Myers, San Francisco, agents.

MESTA MACHINE CO., Pittsburgh, Pennsylvania. Bulletin N, illustrating and describing air-compressors and vacuum pumps.

CONTINENTAL CAR AND EQUIPMENT CO., Highland Park, Kentucky. Catalogue C. P., illustrated, describes Continental dump cars.

SANTA CRUZ PORTLAND CEMENT CO., Crocker Bdg., San Francisco. Illustrated pamphlet on the Aberthaw tests on concrete in sea water.

GENERAL FIREPROOFING CO., Youngstown, Ohio. The fireproofing handbook, third edition. Pacific Building Materials Co., 521 Market St., San Francisco, agents.

PACIFIC FLUSH TANK CO., Chicago and New York. Illustrated catalogue describing design and operation of Imhoff tanks for settling sewage and treating the sludge.

DURIRON CASTINGS CO., New York. Illustrated catalogue descriptive of 'Duriron,' the acid, alkali, and rust proof metal. Yuba Construction Co., San Francisco, agents.

LANGFORD, FELTS & MYERS, Rialto Bdg., San Francisco. Folder describing Marsh-Capron concrete mixers. Illustrated catalogue on the Parsons Traction Trench Excavator.

T. L. SMITH CO., Majestic Bdg., Milwaukee, Wisconsin. Illustrated catalogue descriptive of Smith crushing equipment. Parrott & Co., agents, San Francisco and Los Angeles.

INDUSTRIAL WORKS, Bay City, Michigan. Catalogue describing pile drivers, crane pile drivers, and steam hammers. Bulletin 210-1913. Book No. 108, illustrated and describing locomotive cranes.

JOSEPH T. RYERSON & SON, Chicago. Bulletin No. 9071, describing the Ryerson high-speed friction saw; Bulletin No. 13,071, the Lennox serpentine shear. Technical library No. 8, concrete reinforcing.

ELECTRIC STORAGE BATTERY CO., Philadelphia, Pennsylvania. Bulletin No. 146, illustrated, describing the Iron-clad Exide battery for storage-battery locomotives. Pierson, Roeding & Co., agents, San Francisco.

KELLY-SPRINGFIELD ROAD ROLLER CO., Springfield, Ohio. Illustrated catalogue on 'A Quarter Century's Achievement of the Kelly-Springfield Road Roller.' A. L. Young Machinery Co., 26 Fremont St., San Francisco, agents.

ORENSTEIN-ARTHUR KOPPEL CO., Rialto Bdg., San Francisco. Catalogue No. 900, illustrated, describing portable railways, narrow-gauge sidings, industrial railways, narrow-gauge public railways, and railway equipment of all kinds.

KERR TURBINE CO., Wellsville, New York. Bulletin No. 28, tests of a 7,200,000-gallon economy turbine-driven water works pump for the city of Youngstown, Ohio. Frank R. Wheeler, district manager, Rialto Bdg., San Francisco.

HESS FLUME CO., 2166 Fifteenth St., Denver, Colorado. Catalogue No. 114, illustrated, showing various applications of Hess flumes. In addition, much valuable engineering data are given as well as instructions for erecting and assembling. This is an excellent type of the modern idea in trade publications in which facts and figures have superseded empty generalizations.

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